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THE JOURNAL OF THE

# THE INSTITUTION OF PRODUCTION ENGINEERS

VOL. XXVII - No. 10 - October, 1948

Contents :

ASSOCIATE MEMBERSHIP EXAMINATION

BALANCE SHEET, 1947/48

AN APPROACH TO PLANNING FOR PRODUCTION
*by J. W. BUCKLEY, M.I.P.E.*

MANAGEMENT
*by Lt.-Col. C. W. MUSTILL, M.B.E. A.M.I.Mech.E., M.I.P.E., Assoc.I.H.V.E.*

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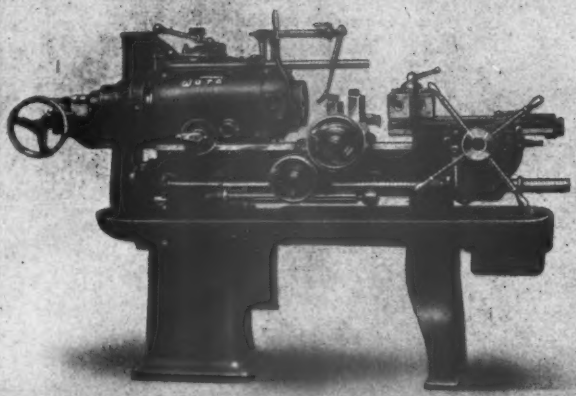

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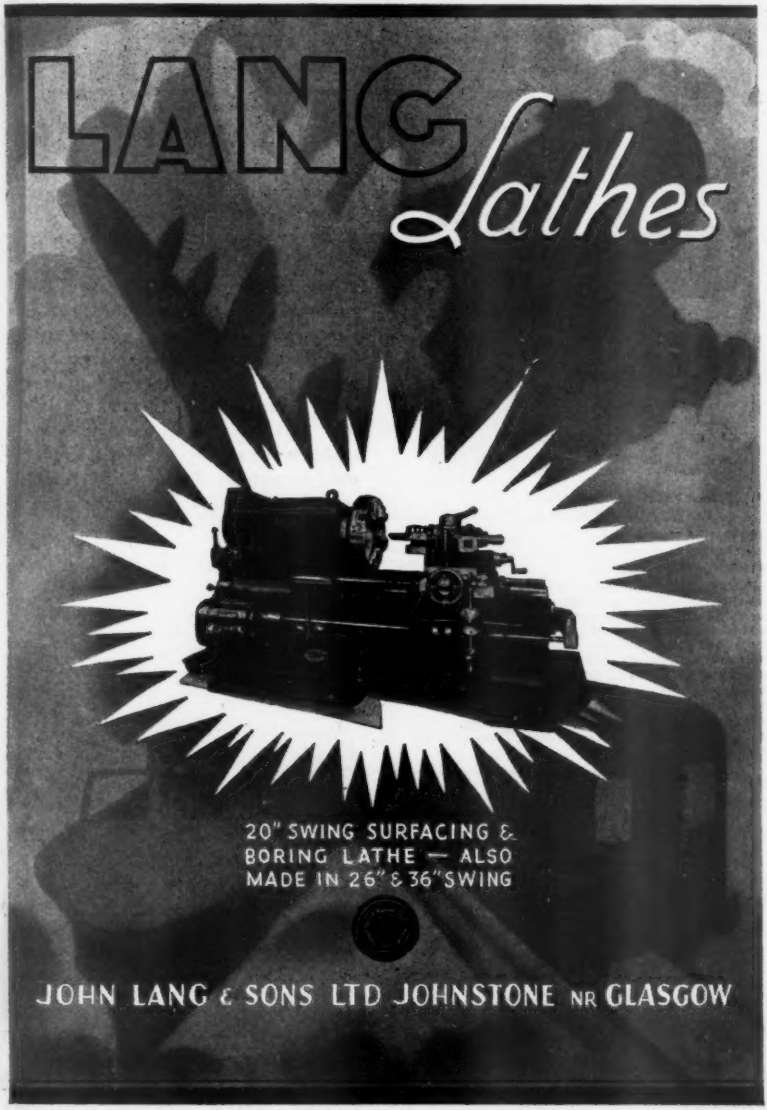
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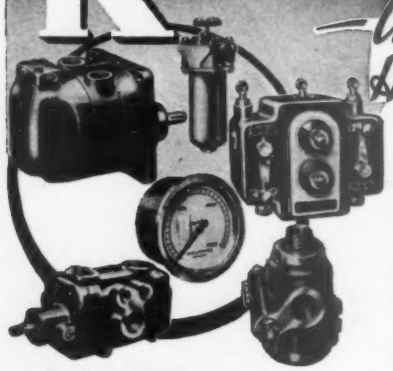

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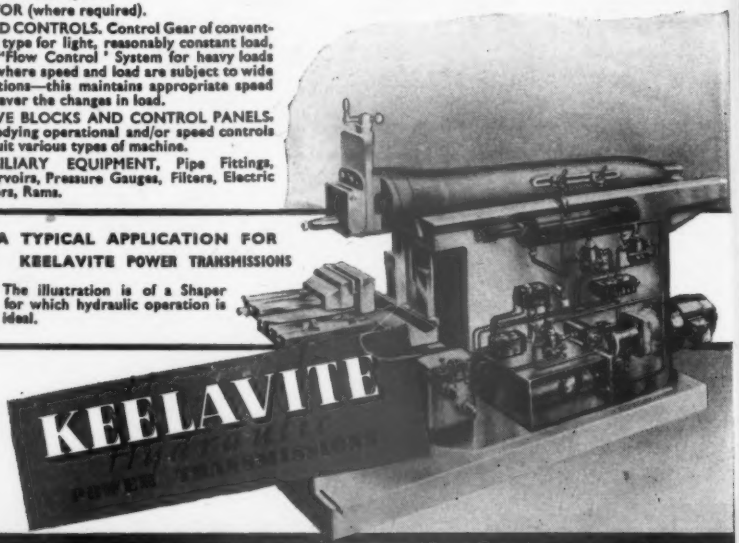


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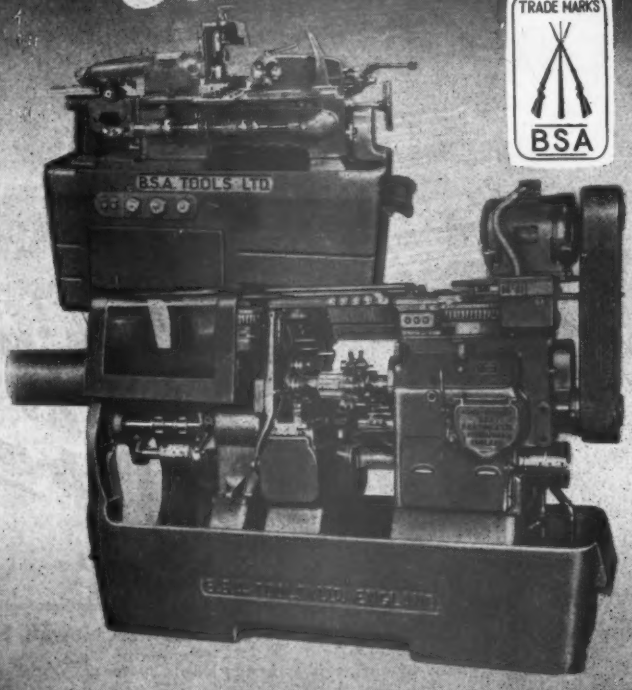


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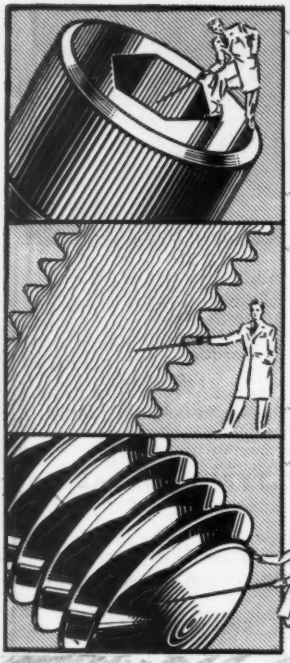

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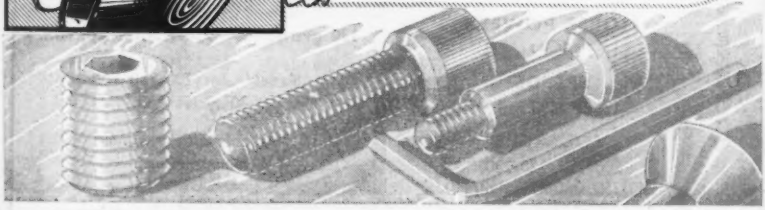

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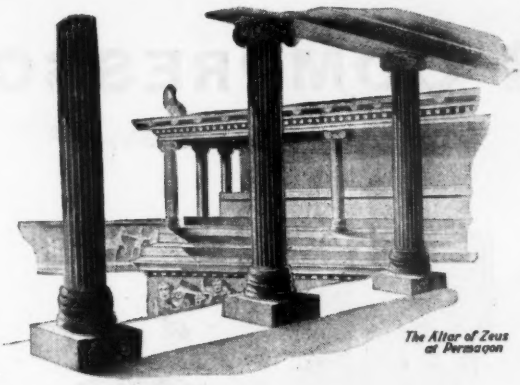

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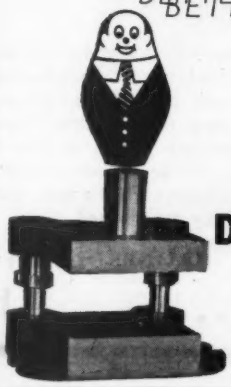

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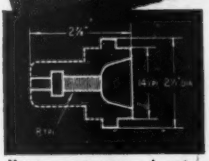

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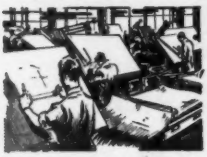

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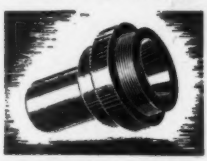

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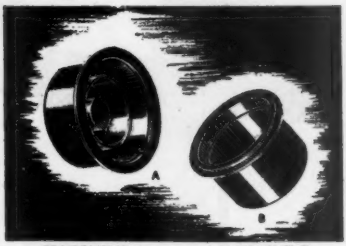


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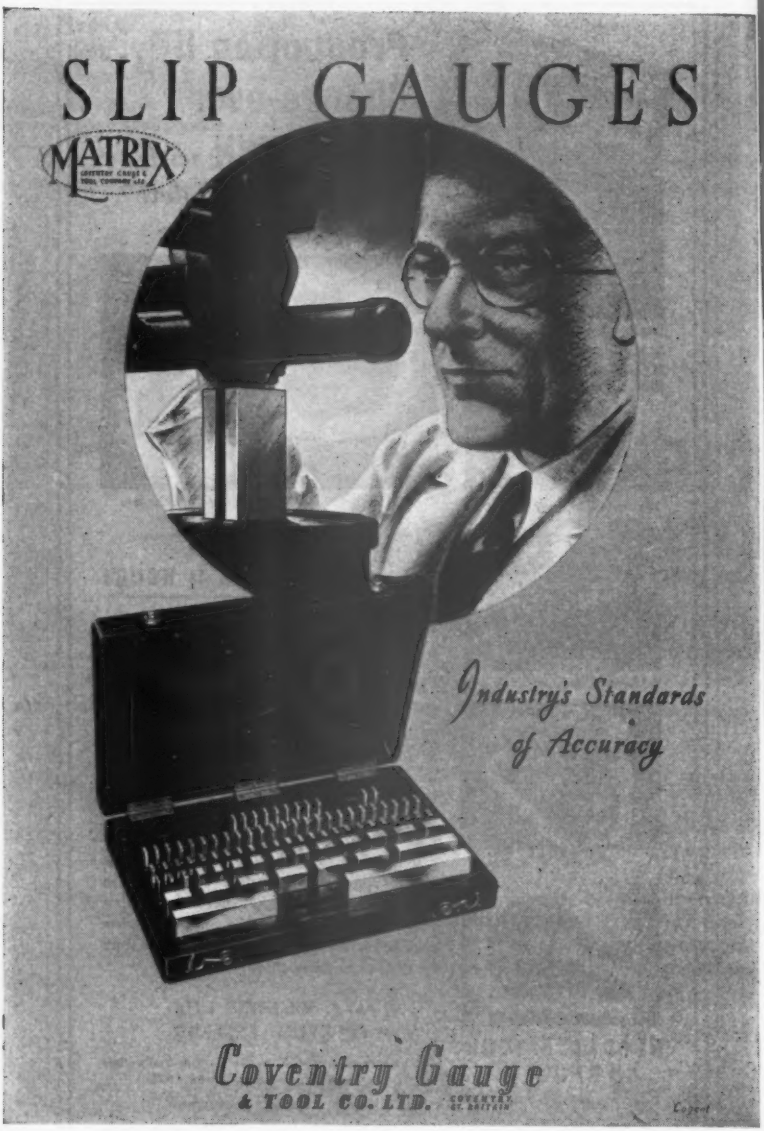
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# MR. R. BLACKBURN, O.B.E., M.I.P.E., F.R.Ae.S.

Robert Blackburn is undoubtedly one of the most dynamic and versatile personalities in the ranks of the Institution of Production Engineers. It is nearly forty years since he designed his first aeroplane, and he can justifiably claim to be one of the very few pioneers of the aircraft industry whose faith in the ultimate possibilities of the aeroplane has never wavered, despite the many early setbacks and disappointments.

In the years before the first World War, he produced a number of exceedingly good aeroplanes which made history at that time. One of his machines was the first to fly across the Bristol Channel.

A Yorkshireman, Robert Blackburn was born in 1885. He was educated at Leeds Modern School, and took a degree in engineering, with honours, at Leeds University. Subsequently he studied practical and technical engineering in Germany, Belgium and France. It was while he was in France that he first took an active interest in aviation, stimulated undoubtedly by his meeting with the Wright Brothers, and on his return to England in 1908 he at once commenced experiments in flying. It was typical of him that he actually designed, constructed and piloted his first machine within a few months of his return from Paris.

In 1912, despite a great deal of opposition from his contemporaries Mr. Blackburn formed a private company for building aircraft. The success of the company to-day is almost entirely due to his prescience and persistence. He has conducted the business from its inception as an entirely personal affair, and to-day still exercises a controlling interest.

By 1914 he had made striking progress and the actual part taken by the Blackburn Company in the First World War is now a matter of history. Subsequently, Blackburn's developed more fully the construction of aeroplanes and flying boats for commercial purposes.

Mr. Blackburn was instrumental in starting many factories abroad, and in March 1927 the Greek Government conferred upon him the Gold Cross of the Order of the Saviour in recognition of his work in Greece—the establishment and organisation of the Greek National Aircraft Factory at Phaleron, near Athens.

At the end of the First World War, Mr. Blackburn received the O.B.E. in recognition of his services to the country. In 1918 he was made a Fellow of the Royal Aeronautical Society and in 1947 he was elected President of the Yorkshire Section of the Institution of Production Engineers. In addition to his membership of the leading engineering institutions, he is also Honorary Colonel of the Royal Army Service Corps.

He was one of the first Yorkshiremen to take up motoring, and is a member of the Royal Automobile Club and also the Royal Aero Club.

# INSTITUTION NOTES

*October, 1948*

**COUNCIL MEETING** The next meeting of Council will take place on Thursday 28th October, 1948, at 11. am. at 36, Portman Square, London, W.1.

**SECTION BOUNDARIES** The attention of members is drawn to the fact that no official Section boundaries have ever been established by the Institution. The final choice of Section naturally rests with the individual member. New members are allocated a Section by Head Office, but any member wishing to change his Section is free to do so, regardless of his place of residence, and the necessary arrangements can be made on application to Head Office.

**RESEARCH PUBLICATIONS** Members may be interested to note that the following Research Department publications are obtainable from the Production Engineering Research Association of Great Britain, "Staveley Lodge," Melton Mowbray, Leicestershire. The prices quoted do not include postage.

"Practical Drilling Tests," 21/-.
"Surface Finish," 15/6.
"Machine Tool Research and Development," 10/6.
"Standardisation and Practical Application of Cutting Tool Nomenclature," 5/-.
"Accuracy in Machine Tools," 3/-.
"Production Engineering Research," 5-/.

**COVENTRY SECTION AWARD** The Institution is pleased to record that considerable interest has been stimulated in the activities of the Coventry Section by the generosity of one of its members, Mr. Douglas D. Davis, A.M.I.P.E., who has agreed to donate an annual prize of Ten Guineas for the best paper prepared and delivered by a Student or Graduate Member of that Section. The paper may be on any aspect of Production Engineering technique, and the first award will be made this year.

## NEWS OF MEMBERS

Mr. D. Braid, A.M.I.Mech.E., M.I.P.E., has been appointed Works Manager of Masson Scott & Co., Ltd., London. Mr. Braid has been a member of the Committee of the Eastern Counties Section of the Institution since 1939 and Secretary until 1946, when he resigned owing to pressure of business.

Mr. L. Bunn, M.I.P.E., a long-standing member of the Technical and Publications Committee, has been appointed a Director of Gay's (Hampton) Ltd., Hampton, Middlesex.

Mr. G. E. Finch, A.M.I.P.E., who is at B.O.A.C., Brentford, is Planning Engineer (Special Duties) Home Bases.

Mr. A. J. Mansell, A.M.I.P.E., Hon. Secretary of Birmingham Section, has been appointed General Secretary of the newly-formed Institute of Industrial Supervisors. This is to be a national body with headquarters in Birmingham, and its work will be mainly educational among foremen and supervisors in all industries.

Mr. A. McLeod, M.I.P.E., has been lecturing in Holland on "The Influence of 200 Years of Scottish History on the Industrial Revolution", at the invitation of the English Association of Holland. Arrangements were made for the lecture to be given in Amsterdam, the Hague, Eindhoven and Maastricht.

Mr. D. H. Morgan, A.M.I.P.E., is now Technical Assistant to the Head of the B.T.H. Choke Factory at Nelson, Lancashire.

Mr. W. H. Shilling, A.M.I.P.E., has been appointed Chief Methods Engineer with Davey Paxman & Co., Ltd., Colchester.

Mr. N. H. Smith, M.I.P.E., has been appointed a Director of Messrs. Ham Baker & Co., Ltd., Langley Green, Birmingham. Mr. Smith has been Works Manager of this company for the past twelve years, prior to which he was Production Engineer for the same firm.

Mr. R. T. M. Toyn, A.M.I.Mech.E., M.I.P.E., M.I.B.F., is now Efficiency Manager with the Lockheed Hydraulic Brake Co., Leamington Spa.

Mr. A. C. Trubshaw, M.I.P.E., has been appointed Works Manager of A. C. Wickman, Ltd., Coventry, and not Manager, as stated in the August issue of the Journal.

**VISITOR FROM ABROAD** Mr. E. J. Brooks, M.I.P.E., of the Sydney Section, proposes to visit this country early in October. Mr. Brooks, who is a Director and Works Manager of Slazengers (Aus.) Pty. Ltd., first went out to Australia as Factory Manager of Claude Wood & Co. Following the death of Claude Wood, Mr. Brooks started a new company, the Dominion Racket Co., of which concern he was Managing Director. Later he accepted the appointment of Factory Manager of Slazengers (Aus.) Pty. Ltd., subsequently becoming Works Manager and Director.

**EDUCATIONALIST'S NEW POST** Dr. W. A. J. Chapman, M.Sc., M.I.P.E., who has been Principal of the Stafford Technical College for nearly four years, has been appointed to a similar position with the new Hatfield Technical College which is being built by the Hertfordshire Education Committee.

Dr. Chapman, who is to take up his duties early in 1949, is to supervise the planning and erection of the college in addition to supervising technical education in the county. A specialist in technical education as applied to production engineering, he is also the author of many technical works, and his "Workshop Technology" was adopted by the Government for the post-war training of Servicemen.

Dr. Chapman has been President of the Wolverhampton Section of the Institution, and is a member of the Council of the Union of Educational Institutions.

**OBITUARY** The Institution deeply regrets to announce the sudden death of Mr. J. T. Kenworthy, M.I.P.E., Member of Council and Founder Member of the Institution.

Since its early days, Mr. Kenworthy had done much valuable work for the Institution, particularly in the Educational field. He was largely instrumental in inaugurating the Western Section in 1933, and acted as Honorary Secretary until the end of 1936. He was President of this Section from 1940-1942, and had been a Member of Council since 1940.

His keen interest and ability in education matters led to him becoming a member of the Education Committee and Joint Examination Board in 1940, and of the Membership Committee in 1943. He was Chairman of the Education and Membership Committees for two years until June, 1946, when he had to resign owing to ill-health. It was largely due to his efforts that an Education Officer was recently appointed to the Institution.

Mr. Kenworthy was Chief Quality Observer in the Engine Division of the Bristol Aeroplane Company, and during the war years, as Technical Liaison and Co-ordination Officer to a group of Midland factories operating under a Government shadow scheme, took a prominent part in organising the production drive in the aero-engine industry. During this period he also became a member of the Ministry of Supply Diamond Tool Technical Panel and represented the Institution on a number of B.S.I. Technical Committees.

He will be remembered not only as a sincere friend and outstanding engineer, but also because of the courageous manner in which he refused to allow ill-health to interfere with his many activities.

**ISSUE OF JOURNAL TO NEW MEMBERS** Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

**IMPORTANT** In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

## SECTION MEETINGS

The following meetings have been arranged to take place in October, 1948. Where full details are not given, these have not been received at the time of going to press.

**October**

2nd BIRMINGHAM GRADUATE SECTION. The Annual Graduate Section Dance will be held at the "Crown and Cushion" Hotel, Perry Barr.

2nd NORTH EASTERN GRADUATE SECTION. A Visit has been arranged to the Durston Power Station.

4th HALIFAX SECTION. A Discussion Evening—"The Position of the Production Engineer in Relation to the National Economy"—will take place at the White Swan Hotel, Halifax, at 7-0 p.m.

4th YORKSHIRE SECTION. A lecture on "Production Research and Development in America" will be given by Dr. H. Orenstein, M.I.Mech.E., M.I.P.E., at the Hotel Metropole, Leeds.

5th COVENTRY GRADUATE SECTION. A lecture on "An Outline of Die Forging Practice" will be given by Mr. H. M. H. Fox, M.I.P.E., in Room A5, Technical College, Coventry, at 7-15 p.m.

6th LIVERPOOL SECTION. An Informal Discussion—Members only—will take place at the Exchange Hotel, Liverpool, at 7-15 p.m.

6th SHEFFIELD SECTION. A Meeting will be held at The Royal Victoria Station Hotel, Sheffield, at 6.30 p.m., when a lecture entitled "Steel Production—Some Facts and Problems" will be given by Mr. L. Chapman.

6th PRESTON SECTION. A lecture on "Production Research and Development in America" will be given by Dr. H. Orenstein, M.I.Mech.E., M.I.P.E., at Messrs. Clayton, Goodfellow & Co., Ltd., Blackburn.

6th LUTON GRADUATE SECTION. Sound and colour films on "Steel Making" will be shown at the Town Hall, Luton, at 7-30 p.m.

**October**—*cont.*

6th WOLVERHAMPTON SECTION. A lecture on " Metallurgy and Its Importance to the Production Engineer " will be given by Dr. Singer.

8th MANCHESTER SECTION. A Dinner and Social Evening will take place at the Engineers' Club.

9th WEST WALES SUB-SECTION. A sound film—" The Production of High Quality Steel " will be introduced by Mr. J. H. Jones at the Technical College, Swansea, at 7-30 p.m.

12th BIRMINGHAM GRADUATE SECTION. A lecture on " Diecasting " will be given by Mr. H. W. Fairbairn at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7-00 p.m.

12th HALIFAX SECTION. A lecture on " Precision Castings for General Engineering Purposes " (with a sound film) will be given by Mr. F. Hudson at Whiteley's Cafe, Westgate, Huddersfield, at 7-00 p.m.

13th WESTERN SECTION. A lecture on "Management for To-day " will be given by Mr. A. T. Davey, M.I.P.E., at the Grand Hotel, Bristol, at 7-15 p.m.

14th BIRMINGHAM GRADUATE SECTION. A Works Visit has been arranged to Higgs Motors Ltd.

14th CORNISH SECTION. The Presidential Address will be given by Mr. Franklin Pool, A.M.I.Mech.E., M.I.P.E.—" History and Development of Metal Perforating."

15th EASTERN COUNTIES SECTION. A lecture on " The Education of the Production Engineer " will be given by Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E. (Education Officer) at the Lecture Hall, Electric House, Ipswich, at 7-45 p.m.

18th DERBY SUB-SECTION. A lecture on " Development and Application of Resistance Welding " will be given by Mr. C. A. Burton at the Art School, Green Lane, Derby, at 7-00 p.m.

18th NORTH EASTERN SECTION. A lecture on " Material Handling " will be given by Mr. Hartford M. King at the Neville Hall, Newcastle-upon-Tyne, at 6-30 p.m.

19th EDINBURGH SECTION. A lecture on " The Gap Between the Production Engineer and the Manager " will be given by Mr. W. C. Puckey, M.I.P.E., F.I.I.A., at the North British Station Hotel, Edinburgh, at 7-30 p.m.

**October**—*cont.*

19th COVENTRY GRADUATE SECTION. An evening visit has been arranged to Smith's Stamping Works, Coventry.

19th MANCHESTER SECTION. A visit has been arranged, commencing at 2-15 p.m. to the Renold & Coventry Chain Co., Ltd., Didsbury, Manchester.

20th BIRMINGHAM SECTION. A lecture on "The Lost Wax Process in Precision Casting" will be given by Mr. A. Short, Grad.I.P.E., at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7-00 p.m.

20th NOTTINGHAM SECTION. A lecture on "Valid Incentives" by Mr. E. Gordon England, M.I.P.E., F.R.Ae.S., will be given at a Joint Meeting with the I.I.A. at the Victoria Station Hotel, Nottingham, at 7-00 p.m.

21st GLASGOW SECTION. A lecture on "The Gap Between the Production Engineer and the Manager" will be given by Mr. W. C. Puckey, M.I.P.E., F.I.I.A., at the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2, at 7-30 p.m.

21st LEICESTER SECTION. A talk, followed by a discussion, will be given by Major C. B. Thorne, M.C., Director and General Secretary of the Institution, on "Current Problems Facing the Production Engineer" in Room 104, Leicester College of Technology, The Newarke, Leicester.

21st LONDON SECTION. A lecture on "The Position of the Production Engineer in Relation to the National Economy" will be given by Mr. C. B. Colston, C.B.E., M.C., D.C.M., at the Assembly Hall, Royal Empire Society, Northumberland Avenue, W.C.2, (Craven Street Entrance) at 7-00 p.m.

22nd WESTERN SECTION. A lecture on "The Review of Compressed Air and its Practical Application" will be given by Mr. W. J. Ford in the canteen of Messrs. T. H. & J. Daniels, Ltd., Stroud, Glos., at 7-30 p.m.

22nd WOLVERHAMPTON GRADUATE SECTION. A Lecture on "Hydraulics v. Pneumatics in Aircraft" (illustrated with lantern slides) will be given by Mr. S. R. Tyler, G.I.Mech.E., G.R.Ae.S., Stud.I.P.E., at the Wolverhampton and Staffordshire Technical College.

25th HALIFAX GRADUATE SECTION. A lecture on "Tractor Production" will be given by Mr. D. Bailey, A.M.I.P.E., at the Technical College, Halifax, at 7-00 p.m.

**October**—*cont.*

25th MANCHESTER SECTION. A Report on the Machine Tool Exhibition at Olympia will be given by Mr. Hubert Bentley, Assistant Editor of "Machinery" at the Manchester College of Technology.

26th LUTON SECTION. A lecture on "A More Efficient Management Technique" will be given by Mr. Gregory.

27th LONDON GRADUATE SECTION. Lectures by Graduates.

27th LIVERPOOL SECTION. A lecture on "Some Applications and Limitations of Plastics" will be given by Mr. Walter Astle at the Liverpool University at 7-15 p.m.

29th COVENTRY SECTION. A Smoking Concert will be held at the Wine Lodge, Corporation Street, Coventry.

# ASSOCIATE MEMBERSHIP EXAMINATION

by THE EDUCATION OFFICER.

As announced in the September issue of the Journal, a stage of considerable importance in the development of the Institution will be reached in 1950 when the Associate Membership Examination is implemented. Such an examination has both professional and educational value since it represents the agreed standard of academic attainment for the practice of production engineering. Its form is such as to allow considerable flexibility for study in the two major fields of higher technology and management, to which the Minister of Education recently directed the attention of the National Advisory Council on Education for Industry and Commerce.

**CONTENT** The summary which follows shows that the scheme combines fundamentals, technology of production and management, and that it conforms with accepted educational practice. This has been achieved through close co-operation with the Ministry of Education, and those familiar with the Higher National Certificate Scheme in Production Engineering will recognise similar content in the Associate Membership Examination. The range of subjects in Part II permits of selective combination to cover many aspects of production engineering and this preserves a broad technological basis required for production studies.

Although the scheme is complete and represents the Institution's considered policy as to the educational requirements for Production Engineering, it has been designed to allow continuity for those taking management studies to the highest level, in accordance with the report on " Education for Management ". At the same time, by adopting accepted educational practice, little, if any, re-organisation of courses will be necessary in those Colleges conducting Higher National Certificate Courses in Production Engineering. Such courses, approved in 1942, are now held in twenty-seven major technical colleges, and they have become the accepted courses in Great Britain for the education of Production Engineers.

**GRADUATESHIP** Prior to 1942, the Graduateship Examination of the Institution was the only examination in Production Engineering. This examination will remain in force until 1950, when it will be replaced by the Associate Membership Examination. The summary enables the two examination schemes to be compared, and it should be noted that the possession of a Higher National Certificate in Production Engineering, which now gives exemption from the Graduateship examination will give exemption from Part I and

Part II of the Associate Membership examination, these parts being the academic requirements for Graduateship of the Institution. Other exemptions will be considered on a strict subject for subject basis.

**MANAGEMENT** The Management content in Part III embodies a general management subject and a subject which may be termed a managerial " tool ", and in framing this, the recommendations of the report on Education for Management were carefully considered and agreement with any courses resulting from the implementation of those recommendations has been assured. Thus satisfactory completion of the examination will ensure a combination of technology and management which constitutes a sound educational background for production engineering in a wide sense.

**PRODUCTION ENGINEERING COURSES ABROAD** The excellent courses in Production Engineering which have been developed in other countries follow a somewhat different pattern from those in Great Britain, and the effect which the Associate Membership Examination may have on such courses has been given careful consideration, so that questions of exemption and alignment may be efficiently resolved. The pioneer work of those responsible for the development and operation of such courses will receive continued help and support from the Institution through its Committees and officers.

**MEMBERSHIP QUALIFICATIONS AND EXAMINATION REGULATIONS** The scheme is produced in detail in a publication entitled "Membership Qualifications and Examination Regulations", which will be forwarded on application to the Head Office of the Institution.

## Summary of Examination Regulations

| *Associate Membership Examination.*<br>With effect from Sept., 1950.<br>11 subjects required. | *Graduateship Examination.*<br>Until Sept., 1950.<br>4 subjects required. |
|---|---|
| *Part I* (Fundamental).<br>5 Compulsory Papers.<br>1. Workshop Technology.<br>2. Engineering Drawing.<br>3. Practical Mathematics.<br>4. Applied Mechanics.<br>5. English. | *Section A.*<br>One paper.<br>1. Construction of machine tools and jig and tool design, or<br>2. Physical Metallurgy and treatment of metals, or<br>3. The application of electricity to production. |
| *Part II* (Technological).<br>4 papers. Compulsory No. 1 and 2 or No. 3. Plus two others.<br>1. Materials and Machines.<br>2. Jig and Tool Design.<br>3. Machine Tools.<br>4. Metrology.<br>5. Metallurgy.<br>6. Press and Sheet Metal Work.<br>7. Plastic Technology and Presswork (Plastics).<br>8. Welding Processes.<br>9. Hot and Cold Forging.<br>10. Foundry Processes.<br>11. Applied electricity. | *Section B.*<br>One paper.<br>Workshop Practice and Processes. |
| *Part III* (Managerial).<br>2 papers. No. 1 compulsory and No. 2 or No. 3.<br>1. Management Principles.<br>2. Production Planning.<br>3. Work Measurement. | *Section C.*<br>One paper.<br>Factory Organisation.<br>*Section D.*<br>One paper.<br>Planning, Storekeeping, and Costing. |
| Graduateship. Parts I and II. | Graduateship. Sections A, B, C and D. |

# THE INSTITUTION OF PRODUCTION ENGINEERS

## ANNUAL GENERAL MEETING

Notice is hereby given that the Annual General Meeting of the Institution will be held on Thursday, 28th October, 1948, at the Institution's Headquarters, 36, Portman Square, London, W.1, at 4 p.m.

*Agenda*

1. Notice convening Meeting.
2. Minutes of previous Annual General Meeting.
3. Report on Election of Members of Council.
4. Presidential Address.
5. Annual Report of the Council.
6. Presentation of Statement of Income and Expenditure, and Balance Sheet, and Auditors' Report.
7. Election of Auditors 1948-9.
8. Election of Solicitors 1948-9.
9. Votes of Thanks.

By order of the Council,
C. B. THORNE, Director and General Secretary.

*BALANCE SHEET*
*and*
*Income and Expenditure Account for the Year ended 30th June, 1948*

# THE INSTITUTION OF

## BALANCE SHEET

### ACCUMULATED FUNDS AND SURPLUS

| | £ s. d. | £ s. d. |
|---|---|---|
| The Viscount Nuffield Gift ... ... ... ... ... ... ... | 24,428 19 8 | |
| The Lord Austin Prize Fund ... ... ... ... ... ... ... | 100 0 0 | |
| The Hutchinson Memorial Fund ... ... ... ... ... ... ... | 100 0 0 | |
| | | 24,628 19 8 |
| Leasehold Premises Sinking Fund ... ... ... ... ... ... | 1,271 13 4 | |
| Dilapidations Reserve Fund ... ... ... ... ... ... ... | 700 0 0 | |
| | | 1,971 13 4 |
| Hazleton Memorial Library Fund (Amounts contributed to date) ... | | 783 7 3 |
| Life Subscriptions *less* amount transferred to Income and Expenditure Account | | 47 5 0 |
| Income and Expenditure Account : | | |
| Balance as at 1st July, 1947 ... ... ... ... ... ... | 14,976 15 9 | |
| *Less* Excess of Expenditure over Income for the year ... ... | 1,330 19 10 | |
| | | 13,645 15 11 |

### CURRENT LIABILITIES

| | | |
|---|---|---|
| Sundry Creditors ... ... ... ... ... ... ... ... | 2,236 10 3 | |
| Subscriptions Received in Advance ... ... ... ... ... ... | 169 16 7 | |
| Structural Repairs Account ... ... ... ... ... ... ... | 820 0 0 | |
| Furniture and Equipment Account ... ... ... ... ... ... | 195 16 8 | |
| | | 3,422 3 6 |

Note.—There is a contingent liability in respect of the completion of structural repairs and refurnishing of 36, Portman Square.

£44,499 4 8

HERBERT SCHOFIELD, *President.*
J. E. HILL, *Chairman of Council and Finance Committee.*
C. B. THORNE, *Director and General Secretary.*

## INCOME and EXPENDITURE ACCOUNT

| 1947 | | £ s. d. |
|---|---|---|
| 9,391 | To Salaries ... ... ... ... ... ... ... ... ... ... | 10,547 3 6 |
| 629 | „ Rent, Light, Heating and Cleaning ... ... ... ... ... | 673 1 1 |
| 1,220 | „ Section Expenses ... ... ... ... ... ... ... ... ... | 2,086 4 7 |
| 2,874 | „ Printing, Postage, Stationery and Telephone ... ... ... ... | 3,537 13 6 |
| 5,914 | „ Cost of Journal ... ... ... ... ... ... ... ... | 8,455 9 4 |
| 804 | „ Travelling and Expenses of Meetings other than Section Meetings ... ... | 1,484 0 7 |
| 131 | „ Audit Fee ... ... ... ... ... ... ... ... ... ... | 141 15 0 |
| 46 | „ Professional Charges and Insurance ... ... ... ... ... | 50 2 10 |
| 112 | „ Donations and Grants ... ... ... ... ... ... ... ... | 112 6 0 |
| 274 | „ Repairs and Renewals ... ... ... ... ... ... ... ... | 283 11 4 |
| 194 | „ Miscellaneous ... ... ... ... ... ... ... ... ... | 360 8 8 |
| 60 | „ Transfer to Hutchinson Memorial Fund ... ... ... ... ... | — |
| 127 | „ „ „ Leasehold Premises Sinking Fund ... ... ... ... ... | 127 3 4 |
| 100 | „ „ „ Dilapidations Reserve Fund ... ... ... ... ... ... | 100 0 0 |
| 660 | „ „ „ Structural Repairs Reserve Fund (36 Portman Square) ... ... | — |
| 1,500 | „ „ „ Furniture and Equipment Reserve Fund (36 Portman Square) ... | — |
| 175 | „ Amount written off Furniture, Fittings and Plant ... ... ... ... | — |
| — | „ Loss on Sale of Investments ... ... ... ... ... ... | 44 7 0 |
| 1,205 | „ Balance, being excess of Income over Expenditure ... ... ... ... | — |
| 25,416 | | £28,003 6 9 |

# PRODUCTION ENGINEERS

## as at 30th June, 1948

### FIXED ASSETS

| | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| LEASEHOLD PREMISES at cost ... ... ... ... ... ... ... ... | 3,481 | 0 | 0 | | | |
| (Depreciation is provided by a Sinking Fund) | | | | | | |
| FURNITURE, FITTINGS AND PLANT at the net amount standing in the Institution's books at 30th June, 1948 ... ... ... ... ... ... ... | | | | 1,475 | 5 | 3 |
| FUND INVESTMENTS at cost : as scheduled ... ... ... ... ... ... | | | | 24,628 | 19 | 8 |
| (Market Value, £26,247) | | | | | | |
| SINKING FUND POLICIES : as scheduled ... ... ... ... ... ... | | | | 1,971 | 13 | 4 |
| (Premiums Paid) | | | | | | |
| | | | | 31,556 | 18 | 3 |

### CURRENT ASSETS

| | | | | | | |
|---|---|---|---|---|---|---|
| SUNDRY DEBTORS, DEPOSITS AND STOCKS ... ... ... ... ... ... | 3,566 | 11 | 2 | | | |
| PRODUCTION ENGINEERING RESEARCH ASSOCIATION OF GREAT BRITAIN : | | | | | | |
| Balance due on transfer of Assets ... ... ... ... ... ... | 4,000 | 0 | 0 | | | |
| GENERAL INVESTMENTS at cost : As Scheduled (Market Value £4,025) ... ... | 4,002 | 10 | 0 | | | |
| UNITED BUILDING SOCIETY DEPOSIT (South Africa) ... ... ... ... | 100 | 0 | 0 | | | |
| CASH : | | | | | | |
| At Bank and in Hand ... ... ... ... ... ... | 2,802 | 19 | 2 | | | |
| *Less* Overdrafts on Current and Section Accounts ... ... | 1,529 | 13 | 11 | | | |
| | 1,273 | 5 | 3 | | | |
| | | | | 12,942 | 6 | 5 |
| | | | | £44,499 | 4 | 8 |

REPORT OF THE AUDITORS TO THE MEMBERS OF THE INSTITUTION OF PRODUCTION ENGINEERS :

We have obtained all the information and explanations which, to the best of our knowledge and belief were necessary for the purposes of our audit. In our opinion proper books of account have been kept by the Institution so far as appears from our examination of those books. Audited Balance Sheets and Accounts have been received from the South African and Australian Sub-Councils: these Accounts, which were audited locally, have been prepared to 31st March, 1948, and the figures shown therein have been incorporated in the above Balance Sheet and annexed Income and Expenditure Account. We have examined the above Balance Sheet and annexed Income and Expenditure Account which are in agreement with the books of account audited by us and the audited Section Accounts supplied to us. Subject to the fact that the Overseas Sections are made up to 31st March, 1948, in our opinion and to the best of our information and according to the explanations given us the said accounts give the information required by the Companies Act 1948 in the manner so required and the Balance Sheet gives a true and fair view of the state of the Institution's affairs as at 30th June, 1948, and the Income and Expenditure Account gives a true and fair view of the excess of expenditure over income for the year ended at that date.

Aldwych House,
London, W.C.2.
*25th August, 1948.*

GIBSON, APPLEBY & Co.,
Auditors,
*Chartered Accountants.*

## for the year ended 30th June, 1948

| *1947* | | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| | By Subscriptions Received— | | | | | | |
| *14,596* | Current ... ... ... ... ... ... ... | 17,369 | 11 | 7 | | | |
| *292* | Arrears ... ... ... ... ... ... ... | 359 | 2 | 3 | | | |
| | | | | | 17,728 | 13 | 10 |
| *1,163* | „ Interest on Investments ... ... ... ... ... ... ... | | | | 1,166 | 10 | 8 |
| *4,853* | „ Journal Receipts ... ... ... ... ... ... ... ... | | | | 6,100 | 4 | 2 |
| *67* | „ Sale of Publications... ... ... ... ... ... ... ... | | | | 276 | 2 | 3 |
| *797* | „ Australian Sub-Council ... ... ... ... ... ... ... | | | | — | | |
| *100* | „ South African Association of Production Engineers—Donation ... ... | | | | — | | |
| — | „ War Damage Refund ... ... ... ... ... ... ... ... | | | | 1,400 | 16 | 0 |
| *3,548* | „ Research Department ... ... ... ... ... ... ... | | | | — | | |
| | „ Balance, being excess of expenditure over income ... ... ... ... | | | | 1,330 | 19 | 10 |
| *£25,416* | | | | | £28,003 | 6 | 9 |

# INVESTMENTS, JUNE 30th 1948

| | £ s. d. | £ s. d. |
|---|---|---|
| **Schedule of Fund Investments.** | | |
| *The Viscount Nuffield Gift :* | | |
| £7,124 19 10 3½% War Stock ... ... ... ... ... | 7,248 19 8 | |
| £8,389 9 6 3% National Defence Stock 1954/58 ... ... ... | 8,000 0 0 | |
| £9,038 0 0 4% Canadian Pacific Railway Perpetual Consolidated Debenture Stock ... ... ... ... ... | 9,000 0 0 | |
| | | 24,428 19 8 |
| *The Lord Austin Prize Fund :* | | |
| £95 8 5 3½% War Stock ... ... ... ... ... ... | | 100 0 0 |
| *Hutchinson Memorial Fund :* | | |
| £95 8 5 3½% War Stock ... ... ... ... ... ... | | 100 0 0 |
| | | £24,628 19 8 |
| **Schedule of General Investments (Unallocated).** | | |
| £1,000 0 0 3% Defence Bonds ... ... ... ... ... ... | | 1,000 0 0 |
| £274 12 0 3½% War Stock ... ... ... ... ... ... | | 290 0 0 |
| £644 15 2 Ayr County Council 3% Redeemable Stock 1956 ... | | 650 0 0 |
| £615 9 5 London County Consolidated 3% Stock 1956-61 ... | | 620 0 0 |
| £595 18 2 Plymouth Corporation 3% Redeemable Stock 1956 ... | | 600 0 0 |
| £148 3 11 3% War Stock ... ... ... ... ... ... | | 150 0 0 |
| £396 13 8 3½% War Stock ... ... ... ... ... ... | | 400 0 0 |
| £190 16 11 3½% War Stock ... ... ... ... ... ... | | 200 0 0 |
| £37 17 3 3½% War Stock ... ... ... ... ... ... | | 40 0 0 |
| £50 2 6 3½% War Stock ... ... ... ... ... ... | | 52 10 0 |
| Total as per Balance Sheet ... ... ... ... ... | | £4,002 10 0 |
| **Schedule of Sinking Fund Policies.** | | |
| *Leasehold Premises Sinking Fund :* | | |
| Norwich Union Life Insurance Society Policy—Premium Paid ... | | 1,271 13 4 |
| *Dilapidations Reserve Fund :* | | |
| General Accident Fire & Life Assurance Corporation Ltd. Policy—Premium Paid ... ... ... ... ... ... ... | | 700 0 0 |
| | | £1,971 13 4 |

THE INSTITUTION OF PRODUCTION ENGINEERS

# AN APPROACH TO PLANNING FOR PRODUCTION

by J. W. BUCKLEY, M.I.P.E.

With an introduction by Mr. T. B. WORTH, Education Officer to the Institution.

*Presented to the Luton Graduate Section of the Institution, December 10th, 1947.*

**INTRODUCTION** In this paper Mr. Buckley poses some simple yet important questions to young engineers who are training for careers in Production Engineering. His object is to present a general picture and to detail some of the essential requirements for efficient planning—the term being used in a wide sense.

The answers to such questions are more in the nature of spoken thoughts rather than statements of facts, though where no doubt exists Mr. Buckley is emphatic of his conclusions. His attitude is that of an artist viewing his picture from a distance, and although primarily intended for students and graduates, the paper contains much of interest to older engineers and will encourage a refreshing analytical change of mind. Education is a continous process, but it is always necessary to review the ground already covered whilst retaining a clear idea of the ultimate object.

The enthusiastic tone of Mr. Buckley's paper encourages me in this introduction.

T. B. WORTH.

**PLANNING FOR PRODUCTION** Not long ago I asked a group of schoolboys the question : " How would you make a 2BA nut ? " Not unnaturally they were unable to answer this simple question. They obviously lacked certain fundamental knowledge. They would have answered the question quite easily had they known :

(a) What was meant by the term " a 2BA nut ".
(b) The types of materials from which a 2BA nut is usually made.
(c) The various kinds of machines capable of making a 2BA nut.

If we again take this simple question : " How would you make a 2BA nut ? " and compound its complexities many times, we eventually arrive at the stage where we shall be asking the question : " How would you make a motor car, or a ball bearing, or even an instrument ? " in fact, any product capable of being manufactured by mechanical aids. We shall then have moved into the realm of



*The Institution of Production Engineers does not accept responsibility for any statements made or opinions expressed in any papers published in the Journal of the Institution.*

modern production engineering. We require the same kind of basic knowledge to manufacture a motor car as we need to make a simple 2BA nut. If one thinks first of the single machine required to make a 2BA nut and then of the vast number of machines and the attendant industrial organisation necessary to produce a motor car, it immediately becomes obvious that there are other forms of knowledge required in addition to the three I have mentioned.

Knowledge, therefore, is the key! But what sort of knowledge? No one ever suggests that a facility for drawing is a sufficient qualification for an architect, but all too often planning for production is looked upon as a mysterious paper chase initiated by ingenious backroom boys, for the express purpose of exasperating all those who have to follow the brightly coloured trail of forms and systems.

In fact, of course, production planning means very much more than the preparation of process layouts, work labels and so on. These are but the outward and visible signs of the mental process—a means of communicating ideas—a method of blue-printing brains. And just as the architect must possess a wide fund of knowledge to produce a practical plan, so must the Production Engineer apply to his task a breadth of knowledge—often painfully acquired—if he is to do justice to the vital importance of his calling.

It is not too much to say that the whole industrial future of these islands is to-day largely in the hands of the Production Engineer. This Institution is therefore charged with a high duty and a great responsibility and we must see to it that we provide that breadth of vision, imagination, knowledge and skill which will enable us to do justice to our immense and critical task.

It would be easy for me to-night to evade the depth implied by my title by reciting a few " case histories ", but " these I have loved " are only nostalgic memories and looking backward is only the art of romance. For these reasons I shall take advantage of the liberal scope afforded me by my title and deal—I hope—fundamentally with the basic knowledge which I consider is essential for those who carry the heavy responsibility of these days.

First of all, let us examine the term " Production Engineering." I shall not draw on all the learned handbook definitions. I will instead give you a short handy definition which will serve as a broad foundation for our discussion. Production engineering is a technique by which raw materials are transformed into saleable commodities ; by saleable commodities I mean all the things people need and/or desire. We generally think of the term as applied to the limited field of engineering, but the planned production technique is spreading to many other transforming processes besides engineering, coal, food, tobacco, furniture and many others. Even the farmer is wondering how the Production Engineer can help him in his ancient calling. Like all other craftsmen, the young Production Engineer

needs both inspiration and instruction—an attitude of mind to things. Just as the craftsman needs tools, so does the Production Engineer. It is about these tools that I want to talk to you to-night, because without some knowledge of them we cannot plan for production. We generally call these " tools ", " subjects " or " branches of knowledge ". The excellent report, " Education for Management " uses what I believe to be the more appropriate term, " tools ".

What are these " tools " ? I have selected the following and suggest to you that they fulfil our essential needs :—

(1) A knowledge of physical laws—mathematics, mechanics, physics, etc., in fact, the type of knowledge covered by the National and Higher National Certificates.

(2) A knowledge of current production practice.

(3) A comprehensive knowledge of machine tools and other forms of mechanical equipment : (a) ancillary equipment, jigs, tools, gauges, etc., and (b) material handling equipment.

(4) A knowledge of factory design and plant layout.

(5) A knowledge of the purpose of the products manufactured by your company, their design and function.

(6) Production control and Time and Motion Study.

(7) Knowledge of materials.

(8) A knowledge of the economics of industry and commerce.

(9) A knowledge of the fundamental principles of management.

I have made no deliberate attempt to place these in order of importance. You will find a need for all of them some time in your career and they will each in turn assume importance. Let us now discuss these " tool " subjects in more detail.

**KNOWLEDGE OF PHYSICAL LAWS**

However great the urge might be to start evolving practical applications, early and earnest attention must be given to learning these basic and fundamental subjects. This knowledge is necessary not for its own sake, but as a guide to a better and fuller understanding of all the other subjects I have enumerated. No efforts can be too great in order to acquire this knowledge and the best time to gain it is between the early 'teens and the age of 25. The Higher National Certificate should be the first aim of all those who aspire to be " first-class men " in the technique of production engineering.

The need for this type of knowledge is not always obvious when the gruelling task (and let us make no mistake about the effort needed) of learning is in progress. Few Production Engineers use the calculus in their daily work, but its reasoning is invaluable in order to appreciate certain types of mechanisms. I remember once asking a Technical Schoolmaster : " Why is a knowledge of all this stuff required ? " His reply was : " To prevent the assumption that water will run uphill."

Now I do not suggest for one moment that any of you present to-night suffer from such mental aberrations. The answer I received may appear to you to be foolish, but it does contain a considerable amount of wisdom.

My advice then to those who are still engaged in the task of obtaining their National Certificate is to work hard and long at their studies and don't forget, also, that there is such a subject as English. The art of expression is a vital need in any profession and there is a price for the neglect of it. There have been many good ideas lost because a person could not adequately express them. It is also a fact, I believe, that a high percentage of failures in the professional institutions' examinations is due very often to insufficient attention having been given to the study of our mother tongue.

**KNOWLEDGE OF CURRENT PRODUCTION PRACTICE**

You will notice that I recommend a knowledge of current production practice rather than a need for practical experience. I do not suggest for one moment that practical experience is unnecessary, but I would like to give it as my experience that the man whose knowledge is limited to that gained in the workshop is rarely successful as a Production Engineer. If you agree with my list of " tool " subjects, you will appreciate why this is so.

The need for practical experience is not so much to make the potential Production Engineer a skilled toolmaker or an expert automatic setter, but rather to enable him to appreciate the practical expression of theoretical knowledge. It is intelligent association rather than practice that is most needed. This association with the practical aspect should not be limited to the apprenticeship period ; a close and intimate connection is required throughout your career. Academic knowledge at the best is a brittle thing and it is by observing practical performance and all its implications that it becomes tempered down to a form in which it becomes capable of almost subconscious yet skilled application.

Scientific knowledge is somewhat like good music, inasmuch as it is dependent upon interpretation. I often think that the operations required to manipulate a musical instrument provide a striking example of theory serving practice. The analogy is capable of being continued. Just as the right combination of notes will produce a sound acceptable to the human ear, so will the right combination of certain kinds of knowledge result in balanced and harmonious judgment. The ability to amalgamate the right musical sounds is acquired by practice and association. So it is with production engineering. It is for this reason that practical association is important. It helps one to determine the right combination. Those of you who have suffered the scathing remarks of a music master

and the withering comments of a chief inspector will, I am sure, recognise at least one of the reasons for using music as an analogy for my theme.

**MACHINE TOOLS** I can almost hear some of you saying : " Now we are getting somewhere." I agree with you that modern machine tools are really fascinating, and the young engineer who does not feel a thrill each time a new machine is brought into the factory is not the man to answer the call of production engineering.

We all go through the stage when we tend to measure machine tools in terms of their colour scheme, pattern of scraping and the number of knobs and levers they possess. Beware of these mighty Wurlitzers ! They can play funny tunes—don't start dancing to them too early. Remember the virtue of simplicity.

I remember an old-timer during the war years who was responsible for a large-scale fuse production unit. We fell to discussing methods. Inevitably the talk turned to super-machines ; his judgment on them was : " You can keep 'em "—or words to that effect—" give me a drilling machine, there is nothing that can't be done on them." His shop layout was witness to his partiality in this direction, but I noticed that he had a few automatics performing their tricks too. What I want to stress to you is that it should not be assumed that every job warrants complicated equipment. Simplicity often indicates ingenuity and what is more, good economics. A study of machine tools is the first step in the planning operation. I feel that the young Production Engineer all too often obtains knowledge of them in a very haphazard way and that is why we so often see the " addict " complex in many engineering establishments. There is a right kind of machine for every job. Circumstances may prevent its use, but the selection of the most suitable should be our aim. I therefore strongly advise that you should study machine tools in a methodical and logical manner.

I think the best way is to begin to classify the various types and by way of example you might start as follows :

(a) Automatics with their sub-sections of bar and chucking types,

(b) Milling machines, again under their different types,

and so on with grinders, capstans, etc., not forgetting, of course, our old friend the drilling machine.

A thorough study of the relative merits of the types within each group should be made and a discussion regarding these might prove valuable subject matter for some of your future lectures.

In order to study machine tools in this manner, you will, of course, need literature from suppliers ; in other words, you need a machine tool library. I feel sure that all reputable manufacturers will be only too pleased to supply you with the necessary literature.

Later on in this paper I shall give my views on the Production Engineer's function in modern industry, and I would only add at this stage, that I attach equal importance to the need for acquiring at least a nodding acquaintance with all forms of production equipment ; plating, hardening, die casting, and even general foundry work. It also seems appropriate to remind you that Production Engineers should recognise—certainly more than most do at the moment—the need to deal with the handling of the materials on which they work. Generally we compare well with the U.S.A. on what we might call operational methods. We fail lamentably, however, when we compare our material handling—both in the method and the approach. As the Production Engineer extends his activities into spheres besides engineering, much more attention must be given to this vital subject of material movement. My advice in regard to this is the same as I gave you for machine tools. Do not imagine that every job needs a conveyor belt. The simple principle of " the shortest distance between two points " is adequate on most jobs, but even this is all too often forgotten.

Now a word about jigs, tools and gauges. I do not propose to discuss them in any detail because I notice that you have already arranged a speaker on this very subject during the current session.

You are all well aware of the infinite variety of jigs and tools needed in the engineering industry. Whilst there can be few design rules, there are two fundamental principles which require your attention :

(a) Once again avoid elaboration. Let simplicity be the keynote. Remember that most jigs are nothing more than a special form of vice.

(b) Remember that the use of a jig invariably results in swarf and burrs. Do not let your jig be a swarf container. Do not assume that swarf and burr clearance is a tool maker's and setter's job. Have it designed into the jig.

You might say that every junior tool draughtsman knows about these two points ; maybe, but it is really surprising how many quite senior draughtsmen forget to apply these two simple principles. Indexing fixtures and quick-acting clamps—yes, how they love them ; I used to myself.

Now a few words on acquiring a knowledge of tooling. I recommend the same method of approach as I gave you for machine tools. Start off by classifying them. For example :—

Collets—compare and contrast the various types encountered in standard machine tools. Study and understand the relative merits. The process can, of course, be applied almost indefinitely.

It follows naturally, that I should recommend the same treatment

on cutting tools and gauges, and once again, you need not spend money on books, as tool manufacturers will be only too pleased to supply you with the necessary literature.

**KNOWLEDGE OF FACTORY DESIGN AND PLANT LAYOUT**

I feel that Production Engineers must give this subject more attention than has been their practice hitherto. There is still much to be learned about factory buildings and the layout of equipment. I have in mind not only the constructional details of building, but rather the need for some information about the ideal geographical relationship which should exist in order to make the most effective combination. For instance, we have not yet sufficient data on the relative advantages of vertical movement as compared with horizontal movement. In the past a level site has been generally accepted as the most suitable, but there must be many cases where this is not so. There is scope for considerable research from which we might establish the relationship which exists between factory design and the size of the unit. The practical difficulties of communication are very real when thought is given to the sprawling mass of buildings which make up the average large scale unit. This is one aspect of factory design on which I would like much more information than is available at the moment.

We then come to the question of factory fittings. The differences of opinion on the most suitable lighting for factories is still a bone of contention, and the case for good general lighting as against local illumination has not yet been thoroughly and satisfactorily settled.

More information is also wanted by the Production Engineer on such things as floor surfaces. The effects of heating and ventilating and colour schemes on production efficiency have still to be determined accurately. These questions have in recent years suffered adoption by such functions as Personnel Management, but I believe that it is the Production Engineer who, by research and investigation, should decide the relative importance of these matters and endeavour to determine their effect upon human happiness and productivity.

Then there is the question of merits and demerits of the various forms of plant layout. There are two generally accepted methods, "line" method and "functional" method. Most jobs seem to demand a combination of the two systems. It is obvious that plant layout very largely determines the productivity per unit area. Here again the Production Engineer requires much more data than is available at present. I feel that it should be possible to determine the correct relationship between the two factors for the various types of industrial activities. There are practically as many opinions on this as there are factories. Most factory layouts convey the impression

of expediency rather than design ; opinion rather than pattern. I submit, therefore, that these matters should have the attention of the Production Engineer.

Like many of the subjects coming under the heading of Production Engineering, they require a considerable amount of research and it is to be hoped that the time will not be long delayed when we shall have the Production Engineer adopting the role of the research worker.

The need for knowledge of the purpose of the products manufactured, and their design and function is self-evident and it would be unwise to discuss it in a general paper of this kind.

**PRODUCTION CONTROL AND TIME STUDY**

Production control, of course, is a fairly big subject and I can only touch on it in passing. I just want to stress that it is not something apart from the production engineering function in a factory, but is a link in the chain. It is my opinion that in most factories, the production control mechanism is far too complicated and that this arises from the fact that most of those responsible for devising and operating it are not Production Engineers, and to compensate for their lack of knowledge, elaborate schemes of check and counter-check are in force. It is my view that the Production Engineer, with his practical association, should take more interest in this aspect of the production cycle.

Regarding Time and Motion Study, I strongly advise all those with a leaning towards production engineering to gain a good working knowledge of this vital measuring stick of production before proceeding too far in their career. All too often Time Study is looked upon as a means for the setting of piece-work prices. I am sure that Frederick Taylor did not have this in mind when he started his studies on scientific management some 60 years ago. He used a stop-watch as a means of job measurement or job analysis. By the use of motion study methods, it is possible to develop a measuring stick for your capacity, and I suggest that this should be your approach. Six months training in this vital sphere is not too long, and those of you who have not received this training should be taking active steps to see that you get the necessary experience.

**KNOWLEDGE OF MATERIALS**

Production Engineers have in the past paid far too little regard to materials. We know that certain materials are capable of being easily transformed whilst others offer extremely stubborn resistance. There is a constant battle being waged between functional qualities and those required to perform the transforming process. The metallurgist first produces a material that combines strength with lightness, e.g., the high tensile steels, or perhaps resistance to corrosion ; he must then

direct his attention to a material which will enable the engineer to transform them. So far his efforts have resulted in carbon steel, high speed steel and tungsten carbide. The last named, although limited in its application, has been perhaps the most striking advance made in cutting tools during the last 25 years.

The metallurgist has made a third contribution. He has tackled the problem to some extent at the source. Without impairing the functional qualities of a material he has found it possible to alter slightly its physical properties by adding certain elements to improve machinability. Examples are lead in non-ferrous alloys, sulphur in steel, carbon in nickel and comparatively recently, selenium in the range of stainless steels. More improvements must follow. The combined efforts of the metallurgist and the Production Engineer are important to the material welfare of man. Neither knows enough of the other's problems. They are to some degree complementary, and the Production Engineer should be prepared to make his contribution by first acquainting himself with at least the physical characteristics of the more common materials.

**ECONOMICS AND COMMERCIAL PRACTICE**

In the realm of economics there is much of value to the student of production engineering. It is natural that it should be so when it is realised that economics is largely a study of production and the distribution of wealth. In a paper such as this I can do no more than remind you of its importance and commend it to your attention. As the subject cannot obtain first place in planning for production, a study of it must perforce follow our primary learning. Notwithstanding this, an early realisation of simple economic facts must be appreciated by the young Production Engineer. For instance, a knowledge of the costs within a factory is a matter of great importance. An appreciation of the difference between capital and revenue in the commercial sense is required. How often one finds Production Engineers—both young and old—who lack the knowledge of the prices of machine tools and of the materials on which they have to work. Yet these are fundamental needs if the most economic production methods are to be employed. It is, therefore, most necessary to make price an integral part of your enquiry when studying machines, equipment and materials. A knowledge of the mechanisms of machines, or the properties of materials, without a knowledge of their cost, is like knowing a French noun without its gender. Mechanics and money are integrated to a greater extent than most of us realise.

**FUNDAMENTAL PRINCIPLES OF MANAGEMENT**

No argument is needed to support the contention that production is a major function of management. It follows naturally, therefore, that the Production Engineer should direct his attention to the study and to obtain an appreciation of the underlying principles.

It is interesting to note that many of the subjects I have brought to your attention to-night, are those laid down for a managerial course. It is also of interest, and perhaps not without some significance, that whilst there are literally hundreds of books on the wider administrative function within industry, there are practically none entirely devoted to the theory and practice of production—perhaps this is because the Production Engineer lacks the art of expression.

One book carrying the title " An Approach to Management " which I read a few days ago, dismissed production planning with these few words—" Production planning in workshops and factories requires a separate training combined with practical experience and demonstration, and for this it is thought that no book can serve as a substitute." There will, of course, be a great measure of support for this statement, by all those acquainted with the daily task of evolving production methods ; on the other hand, I read into this observation that the writer is not fully aware of the true relationship and importance which the processing technique should fulfil in industry. Production is all too often looked upon as a narrow specialist function a little apart from the daily affairs of management. It is for this reason, therefore, that I commend to you a wider study of industry as a whole; you should not limit your deliberations to the purely technical aspects of manufacture. The ever-growing tendency towards centralisation is resulting in a menacing bureaucracy of control, sapping both enterprise and initiative. The growing numbers engaged on administration—or so they choose to call it—in respect of both industry and government is a matter of grave concern when regard is taken of the cost burden. This theme is discussed at some length in Mr. Lewis Ord's book " Secrets of Industry ", in which he sets forth his views on why British industry is less efficient than its counterpart in both the United States and Canada. In this book he develops the theme that the solution to the problems in British industry lies in a greater interest in management by those whose experience and knowledge of practical application qualifies them for the task.

I hope that by my brief observations on the subjects which I enumerated in the beginning of my talk I have at least indicated that planning for production is a task of enormous breadth, requiring as it does a knowledge of many subjects. It is the practical expression of man's ingenuity. It is the very substance of modern civilisation. Our problem to-day is a production problem. Our standard of living will always be directly proportional to our efforts. We hear much to-day about the lack of effort—an absence of the will to work ; there may be an element of truth in this assumption, yet men have always had to work and work hard for centuries with always a comparatively low standard of living.

The Chinese coolie labours, but his reward is not luxury. Abundance cannot be achieved by man's physical efforts alone ; plenty will come only from combining muscle with machines.

The last 150 years have seen inventions and mechanical aids unprecedented in the history of man. The trend continues and even quickens, yet an increase in production of only 1½ per cent. per annum compound can be claimed from this vast accumulation of scientific knowledge. Atomic energy—electronics—who knows what the future holds ? The Production Engineer of to-morrow will undoubtedly require a much higher technical training than he has claimed in the past. The practical expression of these new inventions rests largely in the hands of the engineers of to-morrow. It is now all too patently obvious that our survival as a great nation rests solely upon our ability to produce in the industrial sphere, as we can grow but little of our food. The solution must come from a high degree of concentration and mechanisation in industry, as it is only by industrial efficiency that the future can be assured. It is a future in which the young Production Engineer must take a leading part. His efforts must possess a more co-ordinated pattern than hitherto. There must be a closer relationship between the production technicians found in each sphere of industry, and production planners are the only fluxing medium. Too often in this complex age we find those who have found that the task of being a master in their own subject exhausts their capacity. Heaven save us from the narrow outlook of the specialist but those who would rise to the heights must have eyesight to see the view, otherwise their climbing will be in vain. Only a liberal training can give this vision.

The historian Kinglake said of the battle of Inkerman :

" In so far as the battlefield presented itself to the bare eyesight of men, it had no entirety, no length, no breadth, no depth, no size, no shape, and was made up of nothing except small numberless circlets commensurate with such ranges of vision as the mist might allow at each spot. . . . In such conditions, each separate gathering of English soldiery went on fighting its own little battle in happy and advantageous ignorance of the general state of the action ; nay, even very often in ignorance of the fact that any great conflict was raging."

The fight to-day and in the future is of another kind. We lost the battle of Inkerman : we must not lose the battle of production. We can only win it with trained men who in their youth were prepared to pay the price for organised knowledge, and thereby qualify themselves for the task of planning for production.

# MANAGEMENT

by Lt.-Col. C. W. MUSTILL, M.B.E., A.M.I.Mech.E., M.I.P.E., Assoc.I.H.V.E.

*Presented to Yorkshire Graduate Section, December 14th, 1946; Halifax Section, December 8th, 1947; N.Eastern Graduate Section, January 30th, 1948; Luton Section, February 9th, 1948.*

*(Author's Note: The majority of the references to foremen were inserted after the second reading of the paper).*

The object of this paper is to focus attention on certain aspects of management which must be faced fairly and squarely if this country is to maintain its position in the world and regain its former standard of living. The paper, which is controversial in certain respects, is based on the belief that Man Management in the broadest sense of the term is the real key to our industrial recovery.

At the very outset of the consideration of this problem it is clear that we must recognise that we are living in an entirely different sort of world from 1939. This point of view has been admirably summarised in an article entitled: "Let us face the world as it is," which appeared in the June, 1946, issue of the trade publication, "The Crabtree":

"Why do so many people try to plan their activity or attempt to measure their progress on the basis of pre-war conditions? The mental struggle to revert to the *status quo ante bellum* can be seen in Government departments, in business companies, and in the outlook of private individuals.

"This childlike desire to get back to 1939—or the tendency to measure present possibilities by the yardstick of yesterday's accomplishments—is not merely a weakness of some good folk in this country. We find it so much in evidence in every other country that we may well wonder whether it is a contributory cause of the apathy and pessimism which are combining to slow up material and progress and retard world recovery.

"We should face up to the fact that conditions have changed, that we are living in an entirely new kind of world. The changes wrought by the war are so far-reaching that none of us, from schoolboy to captain of industry, is unaffected. Our new world is not only the result of man's purely technical discoveries, startling as these may be. We are passing through a revolution in our political religious, economic and social life as well. Everything is in a state

of flux. Already there is a new relationship between management and labour ; between buyer and seller ; between industry and state."

**FACTS TO BE FACED**

The world we live in is a strange one indeed—it is a world of shortages, of controls, of high taxation, of staggered hours, of frustration and disillusionment. Many of these grave difficulties were inevitable after a six-year-world war in which the major resources of our national wealth and manpower were mobilised to ensure our continued existence as a free nation. In order to finance the war, we sold a great part of those foreign investments on which we had depended to balance our national budget. For six long years the normal processes of replacing the everyday things of life were suspended, leaving a gigantic replacement programme to be faced. The nation is committed to a vast scheme of measures of social security which have all to be paid for. Then the raising of the school-leaving age, together with the continuation of compulsory military service, will materially reduce the labour force available to industry.

What does all this mean ? The answer was well stated by Matthew Wynter writing on October 28th, 1945 :—

" This country has got to work as it has probably never worked in peacetime before. It must work to replace those former ' cost-free ' imports which must now be paid for, pound for pound, by exports delivered in the right place, in the right way, at the right price, and at the right time.

" The brutal alternative is to export population—and then to sink to the status of a third-class Power. Other nations may be able to afford strikes, ' go slow ', out-of-date plant, inflation of wages without a corresponding rise in output, and the 40-hour week. We cannot."

As we look round industry can we say that this inescapable fact is being recognised ? You know and I know that we cannot. Unofficial strikes, voluntary absenteeism, go-slow tactics, intolerance of the opinions of the minority, the continual pressure for higher wages and shorter hours without any guarantees regarding production are all too common to-day. We cannot hide the grim fact that production per head in this country is below the level which must be attained if we are to balance the national budget.

Part of this is due to sheer weariness occasioned by the strain of war years and the austerities of peace ; part is due to human and material difficulties in changing from wartime to peacetime production ; much of it rises from the disappointment and bitterness inevitable when the bright dreams of the promised new Utopia have died with the bleak dawn of present economic conditions. Finally, we cannot overlook the influence of that propaganda which

for years has fostered the belief that high production per man merely means greater profits for the employer and ultimate unemployment for the worker.

**MANAGEMENT'S RESPONSIBILITIES**

You may ask : " What has all this to do with management ? " My answer is that unless management really faces up to the real nature of the problem which confronts it, there is no hope of success. Its task is to meet and overcome, without the stimulus of the common aim of a nation at war, all those controllable influences which are causing the worker to give of less than his best. In other words, the task before us is man management in its broadest sense ; without successful man management the finest plant and the best planned factory are of no avail.

In my opinion, management will have to educate and co-operate with the worker to a far greater extent than ever before. At the same time it will have to fight at all costs against practices and creeds which it knows will ultimately prove fatal to the worker's own interests.

In this matter management will have to be prepared to see its actions regarded with suspicion, resentment and even open hostility. Put briefly, its portion for some time to come is likely to be toil and sweat and tears.

Let us examine the problem in more detail. There is no time in this paper to trace the history of systematic management commencing with Babbage's treatise " On the Economy of Machinery and Manufacturers," published in 1832 and leading up to the work of F. W. Taylor in America at the beginning of the present century. It is sufficient to repeat the characteristic features of scientific management in the order listed by Dr. K. G. Fenelon (former Secretary of the Institution of Production Engineers) in his book " Management and Labour " :—

" 1. The determination of standard times for performing given pieces of work, the elimination of useless motions which cause unnecessary fatigue, and the substitution of the ' best method ' built up from detailed investigations.

2. The standardisation of tools and equipment, the provision of the most suitable tools and appliances for each kind of work, and improved methods of store management.

3. Arrangement and placing of tools and materials so as to be at hand immediately they are required and so as to eliminate unnecessary fatigue and waste of time. An extension of this idea is the moving belt conveyor for assembly operations popularised by Henry Ford, but in use long before his time.

4. Improvements in the workers' immediate environment, e.g., lighting, heating and ventilation.

5. Vocational selection of workers whereby each would be set to perform tasks for which he was best suited.

6. Functional or specialised foremanship.

7. The establishment of a planning department.

8. The 'excepted principle', whereby routine work is separated from the exceptional. This is essential in a large concern to prevent the management being swamped by detail.

9. Cost accounting removed from the general accounting department and placed in the planning department, though interlocked with the main books.

10. The introduction of systems of payment by results."

It can be said that, broadly speaking, this conception of the management function had been generally accepted by 1939. Since that time, however, organised labour has claimed a much greater share in the administration and organisation of the factory. I believe that in many ways this is a good thing. The worker spends a high proportion of his life within the four walls of the factory. It is therefore entirely reasonable that he should be keenly interested in all questions which affect his working conditions and that he should make his views felt through his duly appointed representatives. What seems to me to be entirely wrong is for him to withdraw or threaten to withdraw his labour during periods of acute shortage in order to secure uneconomic wage increases and unreasonable concessions.

The melancholy record of the last two years has provided an illustration of the vicious spiral of increased wages without higher production followed inevitably by an increase in prices. It is part of the task of management to do everything possible to educate the worker to understand that power without responsibility is a dangerous weapon which ultimately will recoil on himself, for whether we like it or not, I believe that the man on the shop floor will continue to influence administration and organisation to a growing extent.

**INFLUENCE OF PARTY POLITICS**

There is one subject which is usually considered entirely outside the scope of this kind of paper and that is the influence of party politics. Though it would, of course, be completely out of place for a technical institution to concern itself with politics as such, it would equally be an ostrich-like outlook if their influence on industry was ignored. The State ownership of great industries as an essential feature of the party at present in power brings politics right into industry.

The dissemination of political propaganda to the workpeople through various channels is a factor which cannot possibly be overlooked, for the political beliefs of the worker colour his attitude

towards management to a marked degree. Under these circumstances I believe that management must clearly recognise the influence of the political factor.

I can do no more than suggest one or two principles for dealing with this problem. I believe that management should never attempt to interfere with a man's political views, whatever they may be, so long as they are kept out of business. In a freedom-loving country such as this, a man should have the right freely to express whatever political beliefs he chooses, so long as such expression does not interfere with his work or with the workers with whom he comes in contact. Equally, management has the right to question the political activities of the worker whether they be to the left or the right, if they interfere with the working of the business or the majority of the workers. In other words, an active internal political worker, particularly the extremist, of whatever party, can be a most unsettling influence in a factory and the management should always be on its guard against this type of man.

There is no doubt that " ca'canny " and " go slow " methods, etc., can exert a most baneful influence on British industry. Management should attempt to deal with such influences by continually stating the true facts regarding the result of such a policy supported by as much evidence as possible. This is a slow and often disheartening process but I am convinced that it is necessary.

Bearing in mind what I have already said, it seems reasonable to regard the modern conception of management as an application of Taylor's principles combined with an increasing share of control by organised labour.

Such being the case, the co-operation between management and labour to which I have previously referred, becomes a matter of vital urgency. Somehow or other the workers must be brought to an appreciation of the true principles which govern industry.

**EXPANSION OF TRAINING SCHEMES**

How then is management to play its part in bringing about this understanding? I believe that the answer is to be found in part by an extension of the scope of our training schemes. I feel that the vast majority of these schemes—admirable as they are in their way—train without educating. They produce artisans and technicians who are largely ignorant of those simple laws of economics from which there is no escape. An elementary understanding of these would surely go a long way towards destroying some of the dangerous fallacies and harmful dogmas which one meets so often to-day. I therefore express the opinion—which you will probably find challenging and provocative—that it is the duty of management to include the study of elementary economics and general affairs in all its artisan training schemes, even if this is done at the expense of some part of the usual syllabus.

I repeat that we simply cannot afford to neglect any opportunity of instilling into the minds of the workers the fact that they cannot escape from the remorseless laws of economics, however much the fact may be temporarily hidden in a seller's market.

I believe that much can be done by management taking the workers into its confidence. Frequently a decision which is entirely sound and obvious at management level may appear illogical or unnecessary to the workers. Surely the sensible thing is to give a brief explanation at the time the order is issued. Such explanations can reach the worker in a variety of ways according to circumstances, e.g., by use of the notice board or statements to works committees. To give a simple example, suppose it became necessary to switch off a large ventilating fan for a certain period each morning ; this might produce a temporary lack of freshness in the atmosphere. The order could be issued without any explanation at all. Alternatively a notice could be posted simply stating the fact. The third method could be to issue a notice detailing the action to be taken and explaining that it was necessary in order to reduce the load on the electricity mains at periods of peak consumption.

Which method is likely to be most effective in eliminating possible causes of complaint? I leave you to answer. I contend that management has to be prepared to adopt this method of explaining an order to an ever-increasing extent, and I maintain that there is no loss of authority or prestige in such a course. On the contrary, a man will invariably obey an order with better grace when he realises its necessity.

This attitude towards co-operation was clearly defined by Mr. Anthony Eden in a speech at Plymouth on 27th October, 1946, when he said :

" Then there is the whole field of industrial relations in the narrow sense of relations between employers and workpeople. The word co-partnership is much used to-day, often with special reference to profit-sharing. To my mind, co-partnership in this narrow sense, though important, is only part of the whole broad problem of industrial relations to which I myself attach the broader term ' partnership in industry '.

" The first essential of real partnership is mutual understanding. The key to an enhanced and more individual status for the workmen in industry is knowledge. All who are employed in industry are entitled to share in the knowledge of its operation and its purpose. All are entitled to be told how its resources are obtained and how its fruits are distributed."

Equally would I stress the need for adhering to a decision, where that decision is known to be the right one, whatever the opposition. I believe that management should always fight for a right principle or against a wrong one, whatever the immediate cost may be. The

average worker quickly senses weakness and a management which can be forced by popular clamour to follow a course which it knows to be wrong will soon cease to be a management in anything but name.

An example of this form of weakness is instanced by the manufacturer relying on the protection of a seller's market for " buying off " discontented workpeople by the payment of entirely uneconomic wages, at the same time passing on the burden to his customers. This attitude, which is happily rare amongst established undertakings with a reputation to uphold, is all too common amongst those manufacturers who are in business simply and solely to make money. Such a policy has the inevitable result of increasing prices far beyond the intrinsic value of the goods.

Even worse is its fostering of the belief amongst a certain class of workman that he can gain anything he wants when labour is scarce, merely by threatening to leave his employment or to strike. When the seller's market disappears, these two characteristics are going to be a heavy burden on British industry. It is my considered opinion that those managements which pay unjustifiable rates of wages merely because they can obtain any price within reason for their own goods are failing in their obligations to the community, and they are following a course which ultimately may prove fatal to themselves. I firmly believe that it is the duty of management to make its attitude on this point unmistakably clear.

In the speech from which I have already quoted, Mr. Eden went on to say :

" It is no less important to ensure that, while partnership is based on mutual understanding, it is also based upon a clear differentiation of function. A team will not work unless there is a captain, and in modern industry it is essential to efficiency to maintain the authority of management. The purpose of joint consultation machinery is to ensure that management is fully aware of the point of view of the workers, and of how their interests are affected by managerial decisions, and on the other hand to make sure that the workpeople fully understand the motive and purpose of managerial decisions.

" For it must be absolutely clear that the responsibility for taking those decisions and for carrying them through rests with management. Any blurring of this position can only militate against efficiency."

**CO-OPERATION BY WORKERS** Successful management is always seeking to increase the morale of the worker by making him feel that he is part of an undertaking of which he can be proud. To illustrate my point let us consider the case of the Eighth Army in the last war. You will remember that it had suffered defeat followed by a long retreat as

far east as El Alamein. It is no disparagement of that gallant body of men to say that when General Montgomery, as he was then, took over command, its morale was inevitably not of the highest. Soon, by methods as unconventional as they were successful, Montgomery raised that morale to a point which had previously seemed impossible. We all know what followed.

True management should always endeavour to increase the pride the worker feels in belonging to an organisation and the interest he takes in its products. I can best bring home my point by another example. During the war I was privileged to go round a world-famous factory. The memory which remains most vividly with me is not a mind picture of outstanding design or production methods—though both these were present in abundance—but the memory of the real pleasure and satisfaction on the faces of the men who came up to the manager as he conducted me round the factory, to say how delighted they were at the success of their latest product. In every case congratulations were mutual. That is the kind of co-operation between management and worker for which we must strive.

Such co-operation can often be fostered by welfare work. I use the term in its very widest sense to include works' canteens, medical services, recreational facilities and the like. We have advanced a long way since the middle of the last century when men, women and children worked under intolerable conditions in what were truly "dark Satanic mills". The first world war produced a great improvement in working conditions whilst the war of 1939-1945 exerted a marked influence in bringing to the smaller concerns those amenities which had formerly been common only in much larger organisations. I feel that the principles and practice of welfare work are so generally accepted by management and workers alike that it is unnecessary for me to make more than a brief reference to some aspects of the subject.

**IMPORTANCE OF WORKING CONDITIONS**

I would, however, stress the importance of an efficiently administered canteen as affecting the well-being of the worker, especially in these times of austere living and staggered hours. Management should never forget that a normal eight-hour working day can be a very long and exhausting period if proper food is not available. I wholeheartedly believe in the serving of tea in mid-morning and mid-afternoon for I am convinced that it has a stimulating effect on output. At the same time, this serving of tea can easily be abused if the management is weak. My own opinion is that it is best not to have a formal break but to deliver tea by trolley and insulated urn service. The sale of cigarettes and the like can be combined with the service if properly organised, without undue waste of time.

As regards ventilation, I would only say that the system should not only be effective but should be regarded as such by the workers ; otherwise there will be endless complaints of draughts or lack of air movement or general inefficiency.

The importance of the correct use of colour in the factory is now being recognised on a much wider scale than previously. Walls, beams, roofs and machines in carefully selected colours can create a cheerful atmosphere with excellent results to the temper of the workers and the lowering of accident incidence.

Colour in a factory should never be employed from an artistic angle for aesthetics have really nothing to do with its correct use.

In an example of a carefully planned colour scheme, machines were painted horizon grey, ceilings were white, walls and uprights were grey-green, fire-fighting equipment was red, first aid boxes were green, floors were grey or buff and danger points such as edges of platforms and pits, low beams and lifting tackle were yellow with black stripes. All this sounds like an artist's nightmare, yet in practice the result was most successful.

The management should wage a relentless and ceaseless war on untidiness and dirt. In this struggle, little help can be expected from the average worker who is most untidy, chiefly through lack of thought.

Safety precautions should receive special attention. To permit belts, gears, etc., to remain unguarded is criminal. Here again the management will often have to contend with the stupid workman who risks injury by removing shields or guards which may impede his free movement. In factories employing female labour, particular attention should be paid to the danger of the more extreme forms of what is known to-day as a " hair do ". Many a girl has been scalped through her refusal to wear the net which would have prevented her hair from being pulled round a moving spindle.

The mention of female labour brings me to the importance of making full allowance for the physical characteristics of women. For instance, seats and rests for use when machining should be designed to take as much strain as possible from the base of the spine whilst the operator should not have to bend forward. It is significant that investigations conducted amongst members of the W.A.A.F. showed that the most common complaint of women on any kind of work was backache. A room with comfortable chairs and couches should be available so that girls may rest at times under proper supervision.

Management should recognise that although she herself may be quite unaware of it, a woman differs from a man in her general approach to factory life. A man expects to remain in industry for most of his working days, the average woman emphatically does not. This makes a difference when considering long term policies.

A first-aid room should be provided in every factory. It may range in size and scope from a camp bed behind a screen to a miniature hospital.

In general a proper welfare organisation will help management to obtain and retain good-class work people but its attraction to labour cannot compare with a generous wage policy. I do not intend to deal with more than one aspect of that fearsome collection of national bonuses, district rates, lieu rates and all the other complications which make up the wage structure of the engineering industry. I propose only to refer to systems of payment by results or financial incentive plans.

**SYSTEMS OF PAYMENT**

In my opinion the ideal system of this kind should possess the following features :

1. It should provide the worker with a guaranteed minimum wage.
2. It should be fair to both employee and employer.
3. It should be thoroughly understood and be supported by both management and worker.
4. It should be simple so that the worker can calculate his earnings without difficulty.
5. There should be no limit to earnings.
6. Its operation should not complicate costing or accountancy.
7. Its standards should be based on time study preferably over an appreciable period.
8. Once fixed, the standards should remain unchanged unless there is an alteration in material or methods.
9. It should not tend to lower quality.
10. It must be capable of ready supervision.
11. It should not produce anomalies in earnings for comparable classes of work.

Straight piecework is very well understood and other things being equal is usually preferred by the worker owing to its simplicity. Under systems of premium bonus such as the Rowan, Halsey and Weir, the worker is credited with a bonus equal to part of the time saved compared with a standard multiplied by his normal rate of pay.

It is instructive to consider the relative gain by employer and employee when a job is completed in less than standard time.

On *pure time rate* the worker gains nothing. The employer benefits from reduced labour costs and reduced overheads.

On *straight piece rates* the worker gains all. The employer benefits from reduced overheads.

Under *premium bonus* systems labour and employer share in the saving. Overheads are reduced in this case also.

I think it is worth while to note for a moment the current attitude of official labour towards incentive systems as exemplified by parts of the Presidential Address of Mr. Charles Dukes to the Trades Union Conference at Brighton in October, 1946 :

" There have been good reasons for the reluctance of unions to countenance the piecework system and those techniques of time and motion study and methods of scientific management associated with capitalist industry. But I suggest that in the new situation resulting from socialising legislation and the closer association of unions with problems of industrial management, the unions will have to reconsider their attitude towards many of these restrictive methods and practices."

This expression of opinion is most significant. In my opinion the application of systems of payment by results is essential to-day if reasonable output is to be obtained per man hour. There are bound to be exceptions to this general statement. For instance in a works containing a high percentage of craftsmen engaged on the manufacture of a quality product, it may be better to combine a generous time rate with a profit sharing scheme such as I shall describe later in this paper. I would, however, repeat that in all normal cases there is a real need for an incentive system whether it is straight piecework, premium bonus or collective bonus.

In the latter, bonus is paid to a group which may be a section, a complete department or even an entire works. Collective bonus systems can obviously assume a wide variety of forms.

A particularly interesting system is one which has been operated in America for the last 16 years by the Nunn-Bush Company, under the title of " The Nunn-Bush Share Production Plan."

The scheme which came into being because of the 1930 slump is designed to ensure that the worker can be paid regular weekly wages regardless of the hours worked by the factory. The plan was based on the principle that for 10 years previously the proportion of wages to gross production had averaged 19.5 per cent. Nunn-Bush, therefore, agreed with their workers that 20 per cent of the gross turnover should be paid as wages. I understand that this conception was explained to the men by saying that out of every 100 pairs of shoes made, the value of 20 was to be the workers' share. This share is divided amongst individuals by a system of differential rates based on personal skill and output.

Every week the worker is paid 1/52 of his estimated annual earnings. Every four weeks the actual earnings are determined from the actual production and any difference is credited to or debited against the worker.

It is claimed that this scheme has been a great success. It is certainly realistic in that the total earnings are very closely related to production. In this particular aspect it bears some resemblance

to various Stakhanovite schemes in Russia. Naturally because of Trade Union agreements and similar factors the Nunn-Bush scheme could rarely be applied in England. Nevertheless, I consider it is worth some study as a successful departure from the more conventional systems of payment.

**A DIFFERENT APPROACH** As example of a different approach I would instance a scheme devised for a craft works in this country. This was designed not only to increase production but also to effect a reduction in uneconomic output obtained by overtime. In other words it was intended to increase both absolute output and output per £1 paid in wages. Here are the broad details :

(1) Weekly output would be measured in suitable units of work according to a table drawn up jointly by the works management and other workers as representing a fair value. The two parties would ascertain the previous week's output every Monday morning. On the fourth or fifth Monday as the case may be, the output for the month would be determined.

(2) Every month the wage bill for the department would be ascertained. To this would be added an agreed proportion of indirect works wages such as tool-room, packing department, canteen, etc. If any labour were temporarily diverted to non-productive work, an appropriate deduction would be made from the wage bill. No management salaries would be included.

(3) The monthly units would be divided by this total wage bill giving a ratio which has been called " the figure of merit." Expressed as a relation—

$$\text{Figure of merit} = \frac{\text{Output in units}}{\text{Wage bill}}$$

(4) From this it will be seen that the figure of merit would be *Raised by*—
   (a) increase in output,
   (b) reduction in the wage bill due to less labour or shorter hours.

   It would be *lowered by*—
   (a) reduction in output,
   (b) increase in the wage bill due to the engagement of more labour and increase in hours worked. The effect of high overtime rates would be particularly marked.

It is, therefore, maintained that the figure of merit is a true measure of output obtained for wages paid.

(5) A target figure of merit would be fixed. This would be based on detailed knowledge of what is reasonable under present conditions. A fixed sum would be granted to the department as bonus for every " point " by which the figure of merit was exceeded. The bonus would be divided amongst the members of the department in the ratio of their normal earnings for the month in question. This system of division is based on the postulate that value of work is directly related to wages paid. Foremen would share in the bonus which would be paid monthly.

(6) Any drop in the figure of merit would be debited against the following month, thus ensuring that output bonus was not earned one month at the expense of the following month when output drops without penalty.

(7) The indirect labour—frequently called non-productive—would be credited with a percentage addition to their wages based on a fair average of that of the direct production departments.

The third example I am describing is based on production value in terms of money, a common basis for schemes of this kind.

The average production value of the factory output is obtained by taking out the figures over the previous few months. The average wages are obtained in the same way. The average production figure is adjusted in conformity with the rise or fall in the selling prices of the product and is further adjusted in accordance with the rise or fall in wages paid. The corrected production figure is known as the " target " production figure. Thus, if the wages rise 5 per cent over the month in question, the average production figure is raised by 5 per cent to give the target production figure. The amount by which the actual production exceeds the target production is known as the true increase ; 25 per cent of the true increase is allocated as bonus for distribution to the workers, *pro rata* to their normal earnings. Administrative details are similar to those of the scheme last described. It will be seen that this system has some points of resemblance to the Nunn-Bush, although it was evolved entirely independently.

The percentage of the increase which is returned to the worker in the form of bonus can, of course, be decided in a number of ways. The advantage of returning a fixed percentage is that both small and abnormal increases are covered without the bonus being small enough to cause dissatisfaction or so large as to be uneconomic to the firm.

In a successful variation of this scheme, a percentage is added to each man's wage equal to the percentage by which the actual production exceeds the target production. Thus, if the target is £30,000 per month and the actual production reaches £33,000 the percentage increase is 10 per cent and so 10 per cent is added to the wage of everyone participating. The great advantage of this scheme is its simplicity and ease of understanding by the men.

Collective bonus schemes in general possess the advantage of being comparatively easy to administer.

They possess the obvious disadvantage of being based on group earnings and their effect on the individual workman is consequently rather indirect. There is a tendency for the worker who is not pulling his weight to be carried by his more conscientious fellows.

The chief application of such schemes probably lies in craft works or factories engaged in job or small batch production.

I have, of course, merely touched the fringe of this most important question of payment by results but I hope I have said enough to show you that there is ample room for ingenuity in devising systems to suit a wide variety of conditions.

**PROFIT-SHARING SCHEMES** And now I come to profit sharing. By this I mean an arrangement between employer and employee whereby the former pays the latter a portion of the profits of the concern. Such a payment is, of course, additional to normal wages and earnings under incentive schemes. In the 10 years prior to the war, the number of firms in England operating a profit sharing scheme varied between 400 and 500. A great deal of interest is being shown in this subject at the present time and a political party has declared it to be one of the chief features of its future programme. As an illustration I am repeating the full details of a profit-sharing scheme which has been operated most successfully for a number of years by a large undertaking with many subsidiary and associated companies. The wording is taken from the book of conditions issued by the undertaking:

**"GENERAL STATEMENT** The Company will voluntarily give a share of its nett profits every half-year to certain of its employees as a bonus for good service. The Company is under no obligation to distribute such bonus, nor has any employee any right in it, for this gift is solely an act of grace. The first six months of an employee's service will not count for bonus. The purpose of the bonus is to induce and reward trustworthiness, punctuality and thoroughness of work in the Company's service. Any employee lacking in any of these qualifications will forfeit the bonus, which is liable to be withheld wholly or partially at the discretion of the Directors.

**"CONDITIONS** 1. The sum allotted to each employee as bonus will be divided into two parts. One part will be paid in cash, the other part will be paid to the Trustees for the credit of accounts in the names of the employees to whom it is allotted.

2. The Company will pay interest to the Trustees on deposits.

3. The allottee shall have no power to withdraw the whole or part of the reserved bonus, or the interest thereon, nor can any advances be made on account.

4. The Trustees will not recognise any claim made by anyone other than the allottee in whose name the amount stands, or the legal personal representative of the allottee and the amount must not be charged in any way.

5. In the event of an allottee leaving the Company's service or death occurring, the total amount standing to his or her credit will be paid out.

6. When any allottee reaches an age at which the Directors consider he or she should retire from service, or is otherwise unable to perform his or her duties, the total amount standing to his or her credit will be paid out.

7. In the event of an allottee being dismissed from the Company's service for fraud or dishonesty, the Trustees may apply the whole or any part of the deposit to the payment of any loss sustained by the Company."

In my opinion such schemes are excellent in that they tend to make the worker feel that he is part of the business and so has a direct interest in its well-being. Such a feeling is bound to increase that co-operation between management and labour which is so vital to-day. I believe that the future will witness the adoption of these schemes on a much wider scale.

An extension of profit sharing is found in co-partnership schemes where the worker's share of the profits is invested in the capital of the business. The worker then acquires the ordinary rights and responsibilities of a shareholder. Such schemes may include provision for the election of one or more of the workers to the board of directors. Co-partnership schemes have never been numerous in the engineering industry. My personal opinion is that they are too indirect in their results to appeal to the majority of workers and their future extension is unlikely.

**WORKS COMMITTEES** I pass on to the subject of works committees. What a growth of these there was during the war!—Joint Production Committees, Welfare Committees, Safety First Committees—Committees of all types and sizes. There is no doubt that their growth reached such dimensions that they began to be viewed with alarm by many managements which regarded such committees as mere time wasters. In addition, the advocacy of this type of

committee as an article of policy by the two main political parties has caused them to become suspect by management who are only too anxious to avoid politics if at all possible. In my opinion this is unfortunate for much excellent work has been done, especially by the Joint Production Committee. I would refer to the words of Sir Robert McLean in his Presidential address to our own Institution on 24th November, 1944, when he said :—

"The Joint Production Committee, except for those few organisations that had already created a Workers' Council as a buffer between management and labour, is a war-time growth. Generally speaking it has been a great success and many of us would deplore its disappearance. I have no doubt that the wit and wisdom of labour and employer will find means to weld it, perhaps in some new form, into the post-war structure of the engineering industry."

I am convinced that Sir Robert is right. A properly organised committee can do an immense amount of good. It must, however, be run on sound lines in a constitutional manner. In the small undertakings there may well be a single works committee dealing with a wide variety of subjects including wages, working conditions and matters concerning production. Such a committee, which would, of course, be composed of representatives of the management and workers in equal numbers, can operate under a very simple constitution. As an example, I am quoting from the minutes of the first meeting of a committee organised on these lines which proved quite successful :

"(1) Both parties present at the meeting agreed that the function of the Works Committee is confined to that of liaison between the Works Personnel and the Works Management. The Committee has no administrative or executive powers. The existing chains of authority and channels of communication between Management and Works are in no way modified by the existence of the Works Committee. The purpose of the latter is to provide an additional channel of communication between the Works Management and the Works Personnel.

(2) It was agreed that unless unforeseen circumstances arose, the future meetings should be held every Tuesday evening at 5.15 p.m.

(3) No questions regarding sick benefits, meals or social activities will be considered by the Works Committee, as these questions fall within the province of the Welfare Committees. The Committee will not consider personal or private matters, which will be dealt with as hitherto. With these exceptions, the Committee will consider any other questions which affect the interests of the Works Personnel.

(4) Wherever possible, advance notice will be given of questions to be raised by either party in order that the relevant papers, etc., may be available.

(5) The minutes of each meeting will be signed jointly by the Works Director and the Chairman of the Works Committee.

(6) Both parties express their determination to do all in their power to make the meetings a success and they express the belief that such meetings will be of considerable benefit in tending to eliminate possible misunderstandings and in producing closer co-operation between the Works Management and the Works Personnel."

In one case in which a works committee was established it was found that a certain amount of resentment was shown by the foremen who felt that there was a possibility of their being side-tracked in certain directions. It was therefore decided to organise a joint consultative body composed of the management, the foremen and a representative from each department. This is an example of an endeavour to eliminate an attitude which might have nullified the good work accomplished by the committee.

**IMPORTANCE OF THE FOREMAN**

Mention of the foremen brings me to a most important point. I would emphasise that there is nothing in the conception of the management function outlined in this paper which reduces the importance of the foreman. Indeed, I consider that there is a clear parallel between the role and status of the foreman in industry and the non-commissioned officer in the modern army ; here it is pertinent to recall the military belief that the strength of any army depends on its N.C.O.'s. Whatever the organisation, the foreman must always form a permanent and vital link between management and the worker.

What qualities, then, should he possess ? I think that these can be divided into three main groups :

(1) Loyalty.
(2) Powers of leadership.
(3) Technical ability.

The relative importance of these groups obviously varies according to the size and nature of the business. However, I say quite definitely whether a concern is large or small, loyalty must go high on the list of those qualities essential to a successful foreman.

Management should always be on the look-out for men with these qualities to be earmarked as potential foremen so that an understudy is always available at short notice—a golden rule at any level in industry.

I consider that management should never promote a man for

sentimental reasons alone or because he has given long service and it is felt that he should receive some recognition. Such promotions invariably lead to loss of efficiency.

I feel I should make brief reference to the Trade Unions which form so important a feature of British industrial life and as such are entitled to the utmost respect. My strongly held opinion is that true management should explain, educate, co-operate and above all, lead, whether the factory is strongly union, partially union or entirely non-union.

**SUMMARY** I shall now endeavour briefly to summarise the views which I have expressed in this paper.

(1) One of the greatest problems which faces industry is successful Man Management, in order that the worker may be led to make that maximum effort which is vitally necessary to the successful future of this country.

(2) The old relation between management and labour has given place to a newer conception in which the worker exercises a great deal more control over the conditions of his employment.

(3) Management should attempt to educate the worker to an elementary understanding of the operation of those economic laws which necessarily affect him.

(4) Management should explain its orders and should take labour fully into its confidence.

(5) At the same time management should recognise to the full its duties of leadership and should never show weakness when a vital principle is at stake.

(6) Everything possible should be done to increase co-operation including the establishment of appropriate works committees.

(7) Welfare in the broad meaning of the term should be regarded as of paramount importance.

(8) Systems of payment by results should be operated whenever possible.

(9) A profit sharing scheme should be established as a general rule.

(10) The foregoing conception of management in no way reduces the importance of the foreman.

I feel that my paper would be incomplete without making reference to a subject which is too often forgotten both at home and abroad, that is the outstanding achievements of British industry during the war. It is therefore a good thing that, from time to time, we should briefly review what was done.

The nation's record in applied research was unsurpassed by any country in the world. Mention of radar, degaussing, jet propulsion,

the initial stages of the development of the atomic bomb, is proof enough of that statement. Can any other country point to the triumphant completion of such projects as Mulberry and Pluto?

I yield to no man in my admiration for the drive and boldness of the industry of the U.S.A. which was fortunate enough to be free from bombing. I pay tribute to the wonderful record of the Soviet Union, even though the results were obtained by methods which are alien to those of this country. But let us shout from the housetops the fact that in this little island, in spite of all that the bomber, the V1 and V2 and the U-boat could do, our war effort per head of population was the greatest in the world.

In the face of such a war record, who can doubt the outstanding ability of the workers of this country and who can question the magnitude of the achievement of management which carried a staggering burden?

It will again be the supreme privilege of management to lead industry through the grim period of shortages and disappointments and frustration which is now upon us—a period as I have already said, of toil and sweat and tears. But if the task is great so is the reward, for this is no less than the restoration of the standard of living to which we are entitled. Of one thing we can be certain—the ability is there.

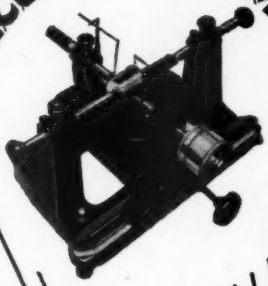
In conclusion may I state in all sincerity my belief that though we now travel through the dark valley of difficulties, ahead of us the sun is shining brightly on the hills of hope.

# Notes

# Notes

# Notes

ACCURATE DIAMETER MEASUREMENTS



**P. V. E.**

DIAMETER MEASURING MACHINES CAN BE USED FOR PLAIN OR SCREW DIAMETER.

THEY ARE MADE IN A RANGE OF SIZES:—

0″ — 2″
0″ — 4″
3″ — 7″
0″ — 7″

P.V.E

0-7″ DIAMETER MEASURING MACHINE (*Illustrated*)

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PHONE: WOOLWICH 4252

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Inter-crystalline corrosion caused through an impurity content of even a few thousandths of 1%, endangers the life of your castings. Protect **YOUR** interests by taking **TWO STEPS....**

**STEP No 1** Specify Zinc Alloy Die-castings which conform to B.S.S. 1004 Alloy A or Alloy B.

**STEP No 2** Contract to have a reliable metallurgical test carried out, as a routine monthly check on the specification of Zinc-Alloy Die-castings taken at random from incoming supplies.

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**GRAISELEY HILL . WOLVERHAMPTON**

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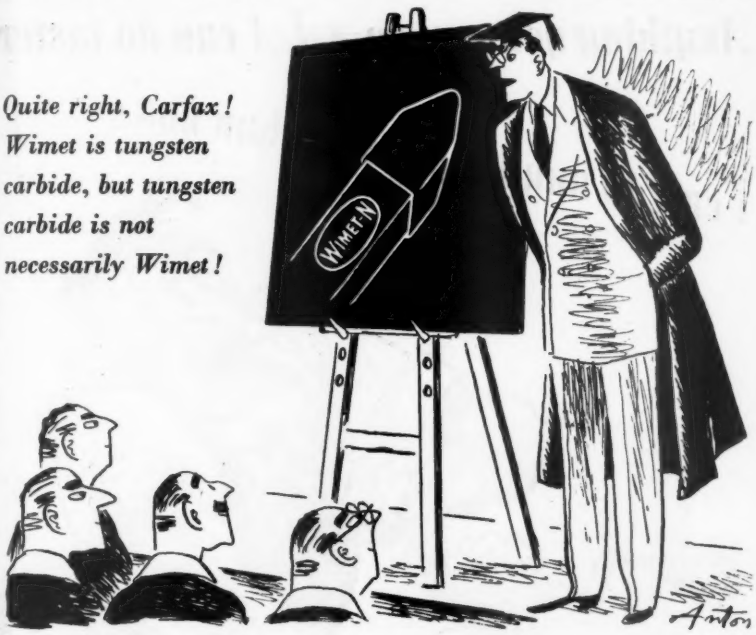
*Quite right, Carfax! Wimet is tungsten carbide, but tungsten carbide is not necessarily Wimet!*




IN RECENT YEARS, the advantages of tungsten carbide tools have been universally recognised. The leader is unquestionably "Wimet," the famous Wickman brand. Wimet has been so successful, in fact, that the name has become almost synonymous with *all* tungsten carbide tools.

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**7 DAYS** *for Rough Cased Nibs up to No. 5 setting ex Works.*
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**Annie — get your drill gun**

**and show this big palooka.**

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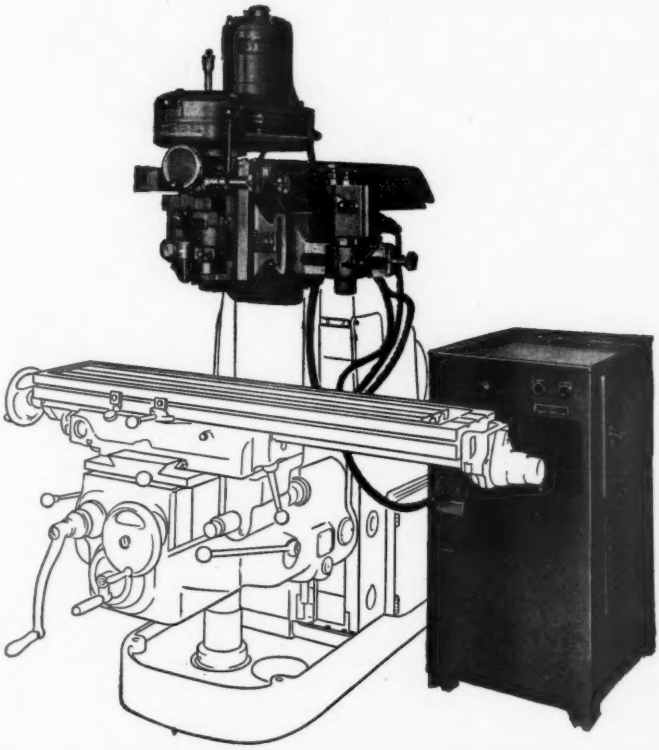
# Of interest to Toolmakers



**The capacity of the mould and die-maker has been immeasurably increased within recent years by the advances made in machine tool design. Two new developments in this sphere are announced by**

# CINCINNATI

**These are the High Speed Vertical Milling Attachment and the Automatic Depth Control Tracing Attachment, which convert 2MI or Dial Type Horizontal Milling Machines into highly efficient die-sinkers for the rapid, economical and accurate production of moulds and dies from plaster, wood or metal masters.**
**The attachments are readily removed ; hence machines so equipped are in no way restricted in their ability to perform orthodox milling operations.**

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*Sales Representatives for Great Britain and Northern Ireland:*
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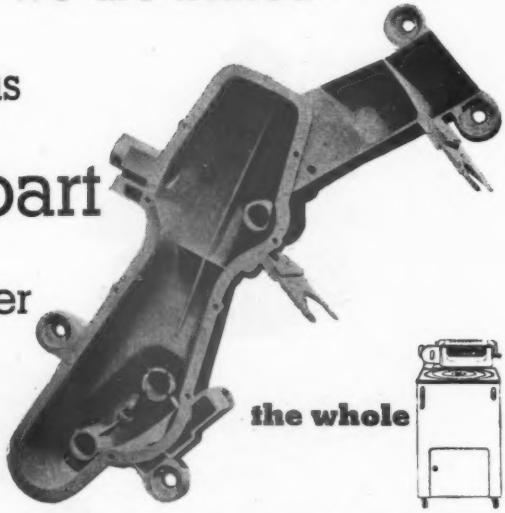
# Maybe we are biased

but to us

# this part

is greater

than



**the whole**

THIS ZINC alloy die casting does a valiant job in the modern home, for it is the gear case of the Hotpoint Washing Machine and Wringer. It is 24" long and weighs 14 lb.*

**Why the part is die cast in zinc alloy**

The gear case is an outstanding example of several different functions combined in one casting. The part must be strong enough to carry considerable stresses; and accuracy is needed in the spacing of the bearing bushes.

This casting also accommodates the mechanism which declutches the impeller drive, and the screws which locate the cover plate. In fact, there's a lot in this single casting, which can be produced in one operation at up to 30 castings an hour.

**Other household equipment, too**

Household equipment of which components are zinc alloy die cast includes wringers, vacuum cleaners, electric fires, food mixers, radio sets and table lamps.

**Some facts about zinc alloy die casting**

Speed of production is the essence of the die casting process — the shortest distance between raw material and finished product. Zinc alloys are the most widely used of all metals for die casting because they yield castings with the following qualities:

STRENGTH: Good mechanical properties for stressed components.

ACCURACY: Castings can be made practically to finished dimensions and need little or no machining.

STABILITY: Close tolerances are maintained throughout the life of the casting.

These properties accounted for the widespread war time use of zinc alloy die casting in the quantity production of such things as fuses, gun sights, periscopes and tank carburettors.

**British Standard 1004**

Alloys conforming to B.S. 1004 should be specified for all applications where strength, accuracy and stability are essential.

ZADCA

ZINC ALLOY DIE CASTERS ASSOCIATION
LINCOLN HOUSE, TURL STREET, OXFORD.
TELEPHONE: 48088.

**ZINC ALLOY DIE CASTINGS PLAY AN IMPORTANT PART IN THE EXPORT MARKET**

Enquiries about the uses of zinc alloy die castings are welcome. Publications and a list of Members will be sent on request.

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How to keep the conveyors of furnaces, ovens and other equipment, freely lubricated at temperatures at which oils burn off is a problem solved by 'dag' colloidal graphite. Available in a variety of liquids, it is easy to apply and stays on the job, unaffected by high temperatures. Maybe you don't operate a mechanical furnace, but you do have your own particular problems of high temperature lubrication. Send off the coupon below to Acheson Colloids Limited, 9 Gayfere Street, Westminster, London, S.W.1 and learn how they can be solved by 'dag' colloidal graphite.

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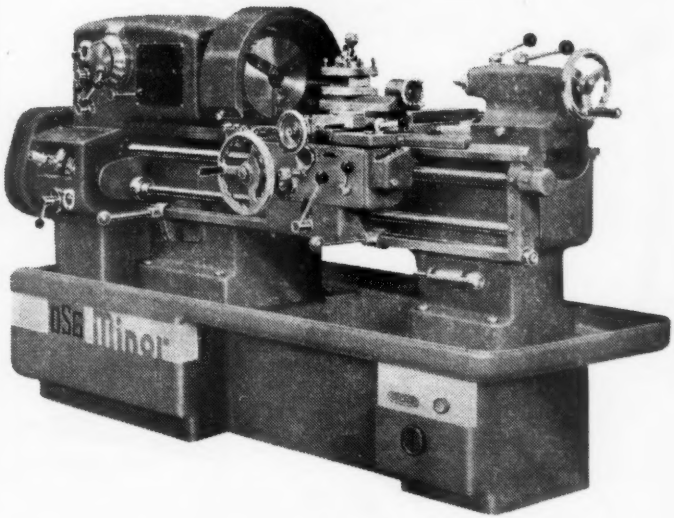


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Swings 13½" diameter over bed.

Length of bed 6' or 7' long.

Admits 30" or 42" between centres

12 Spindle Speeds, choice of 3 ranges: 16·8 to 750 r.p.m., 22·5 to 1,000 r.p.m., or 31 to 1,400 r.p.m.

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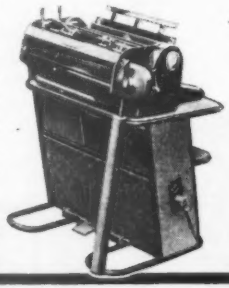
Nine aluminium alloy and eight magnesium ("Elektron") castings are pictured above. They are all components of the large "Fordigraph" Rotary Reproducing Machine, well-known as the "MULTILINEX". The quantities of these larger machines—in comparison with other models in the range—are relatively small, therefore sand castings were recommended. These light alloy parts have the advantage of easy machining—with a beautiful finish—in addition to a very valuable weight economy in the moving parts (the actual saving over ferrous metals is some 50 lb.). There is also a distinct gain in buying such castings "*en suite*" from "BIRMAL", both in the matter of reliability, since only "*specification*" alloys are used, and of balanced deliveries. Frank R. Ford Limited write... "*bearing in mind the specialised nature of our productions, we must offer you our congratulations on the efficient manner in which our many complex problems have been handled by your staff, and on the consistently high quality of your castings.*"



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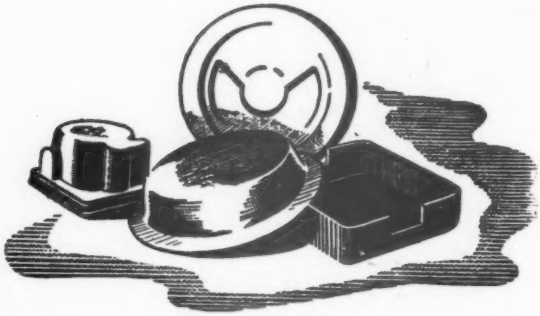
**JOHN LUND, LTD., CROSSHILLS, KEIGHLEY, YORKS.**



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**The removal of drawing pastes and pressing oils is not usually an easy degreasing operation, due to the tenacious nature of these compounds. With SOLVEX, however, the operation can be done quickly and without holding up production. Simple immersion for 7 to 12 minutes in the SOLVEX bath, followed by a quick rinse in hot water is all that is required.**

**SOLVEX requires no elaborate equipment, is non-inflammable, non-toxic and can be used repeatedly without losing its efficiency. Write for details.**

**N.B. Not suitable for paste media containing mineral fillers used in deep press work.**

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N 57

*Will Might, the Mill-wright*
*——and the PROF*
*set-too No. SEVEN*

"YOU see here on the blackboard a rudely indicated representation of the Pupa Hypoderma Bovis. Banish your craven apprehension, Will Might; it is not a portrait, though at first I myself was struck by the uncanny resemblance to *one* of you! However, it is a 'pupa' not a 'pupil'."

"The point to which I would call particular attention in this microcosm (and here we find a second human similarity, Mr. Might) is that these pupa are rarely found where one would like them. On the contrary, these quick change artists are always where they are most objectionable! They start active life by forcing an entry above the hock of that handsome bovine the ox. Thence they migrate to emerge through a hole they contrive in the best part of our esteemed leathermakers anatomy, thus ruining the life endeavour of the faithful animal. They make his hide useless for a Hendrys' Belt—though possibly still of value for some less exalted purpose. On emerging, the pupa, which has adopted the guise of a worm, disguises itself now as a chirpy Warble-fly and gets busy laying eggs to perpetuate the destructive cycle. Who would think that it had anything to warble about!"

"Only a flawless hide is good enough for Hendrys."

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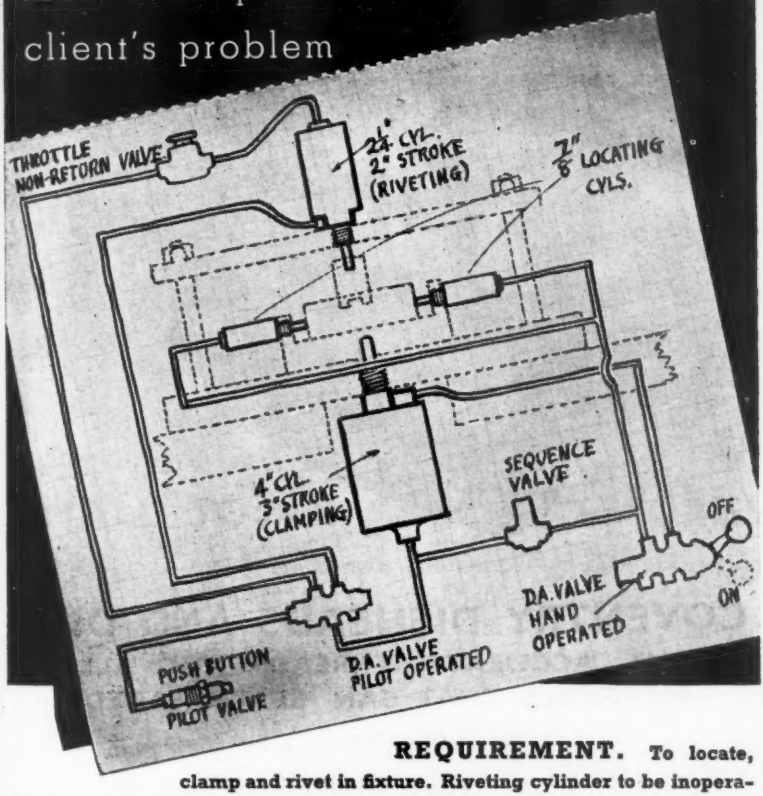


**REQUIREMENT.** **To locate, clamp and rivet in fixture. Riveting cylinder to be inoperative if component is not clamped and operator's right hand not on valve. Operator's left hand to control riveting operation — thereby engaging both hands as a safety measure.**

**FUNCTION.** **Hand-operated valve controls locating and clamping with sequence. Push-button pilot-valve operates pilot-controlled valve and riveting cylinder.**

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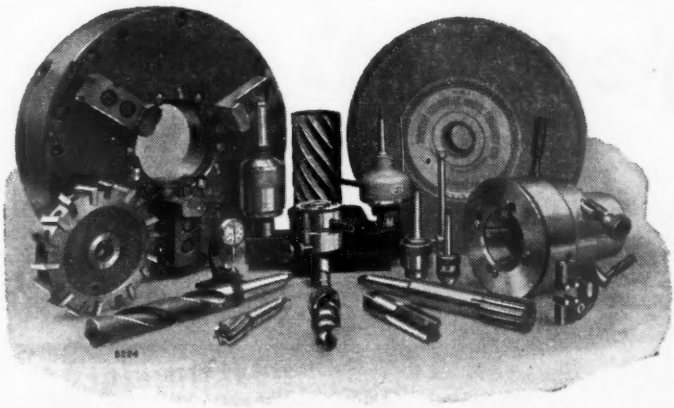

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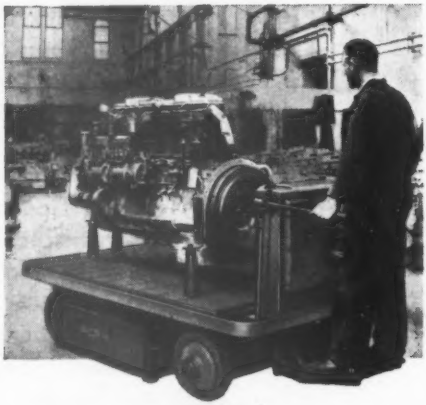

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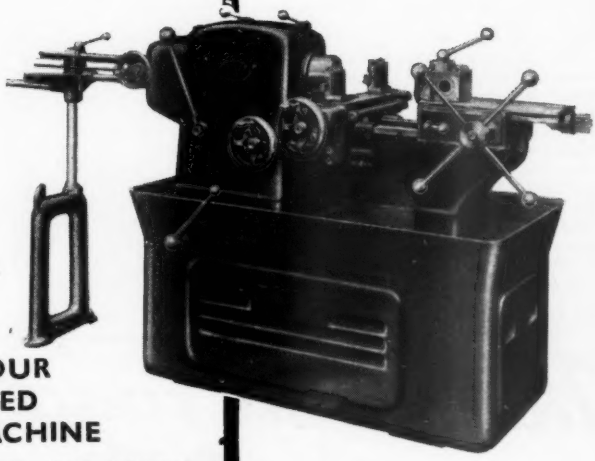
No. 2 Capstan lathe.
Bar Capacity up to 1"
diameter.



## THE HOUR
## THE NEED
## THE MACHINE

This new capstan lathe definitely gives faster production. Relatively few moving parts, some of light alloy, permit extremely fast starting, stopping and reversing movements which are foot controlled to free operators' hands. Capacities up to 2" bar dia. Built-in motor and electrical controls.

★ Trouble free automatic bar-feed. Pneumatic or hand locking for collets and chucks. Rapid interchange between bar and chuck work. Choice of 3 speed ranges, each with 12 speeds (6 if no gearbox). 6 power-feed rates to turret with same feed-shaft speed.

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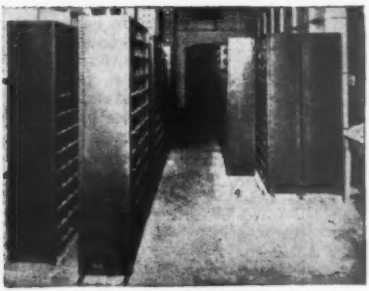

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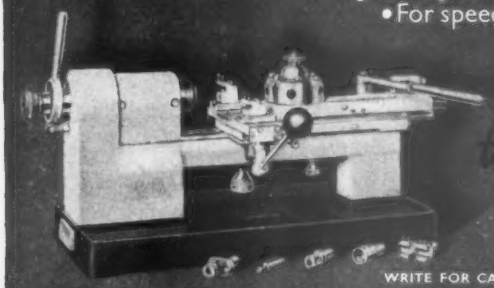

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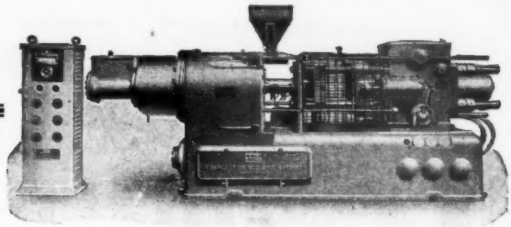

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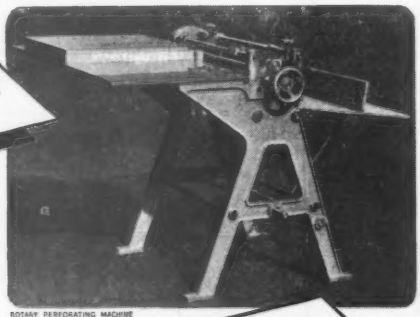

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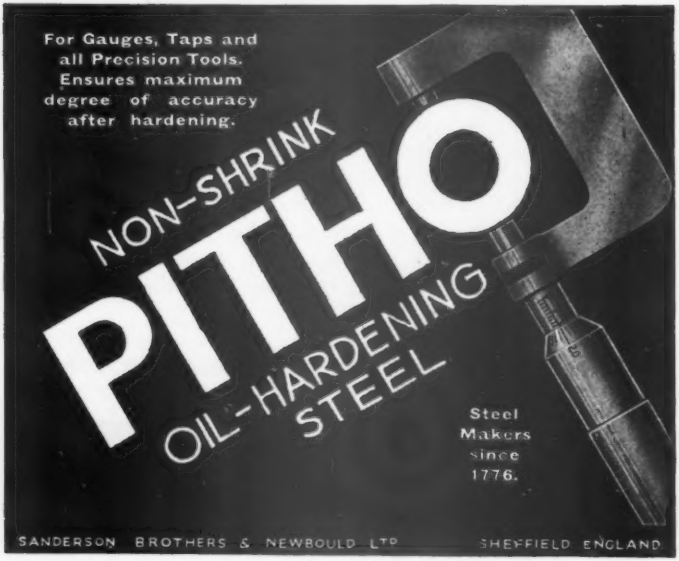
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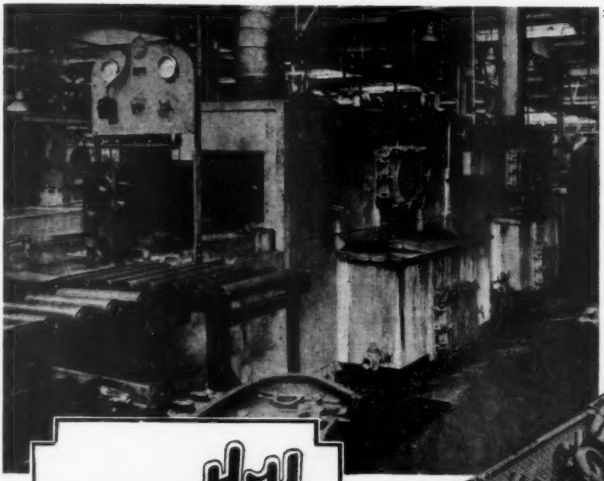

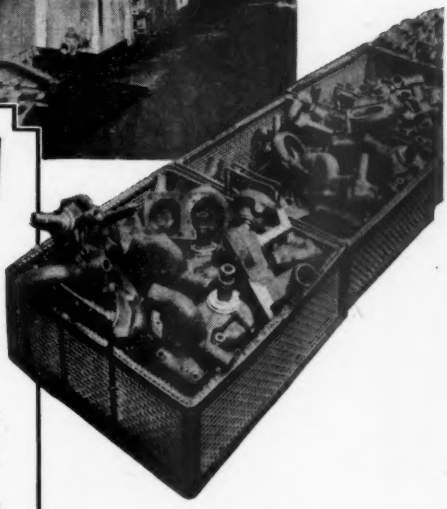

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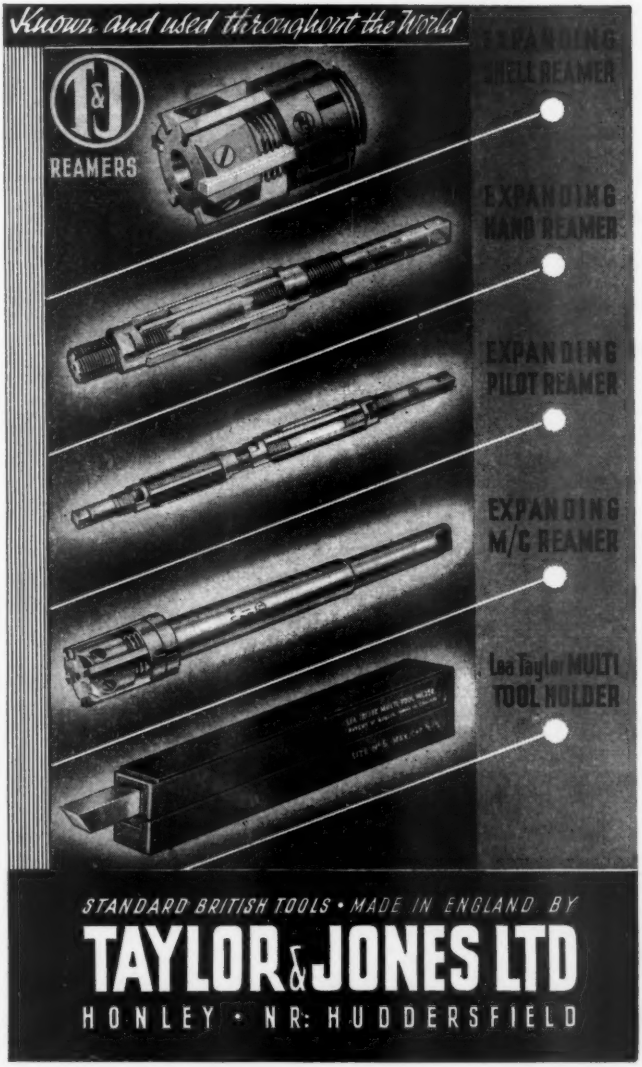
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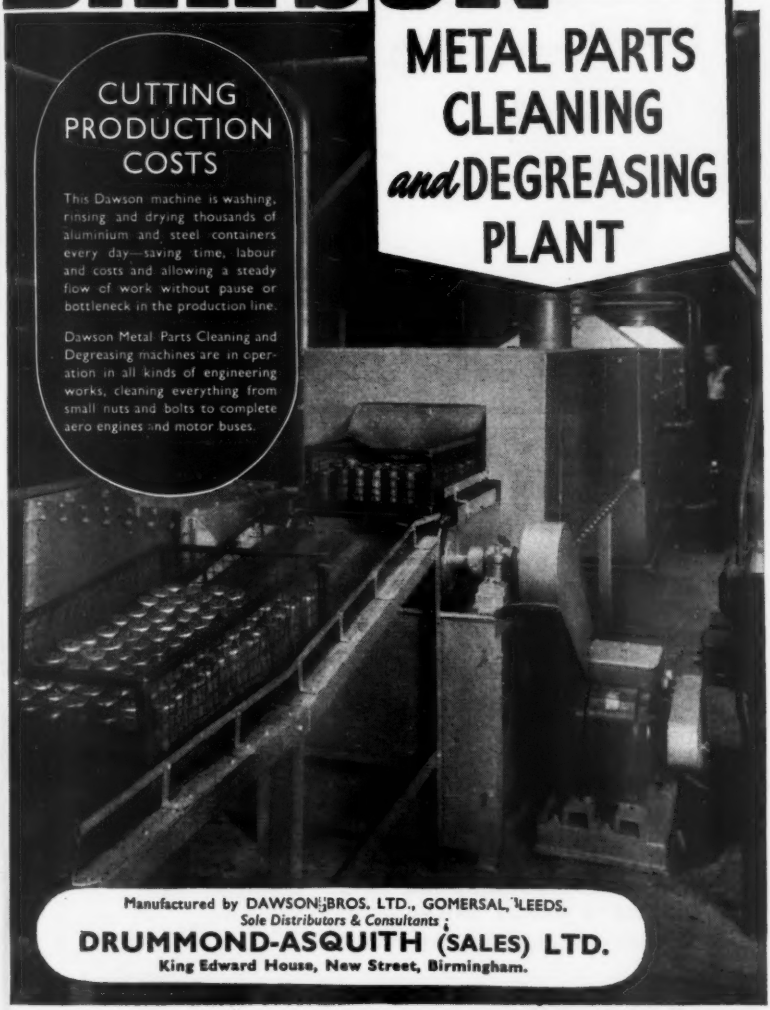

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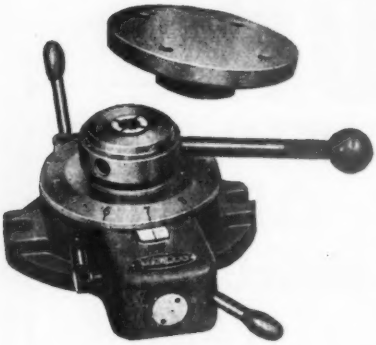

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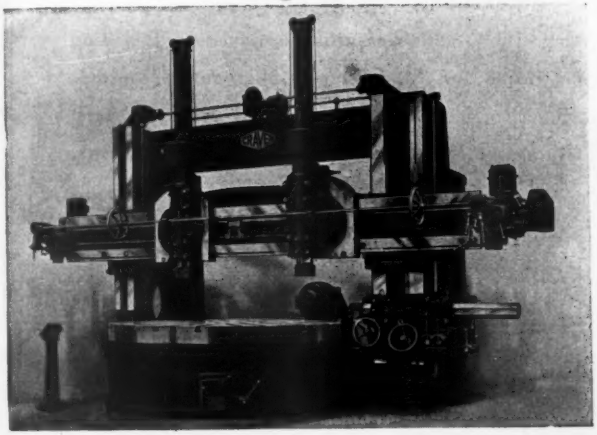

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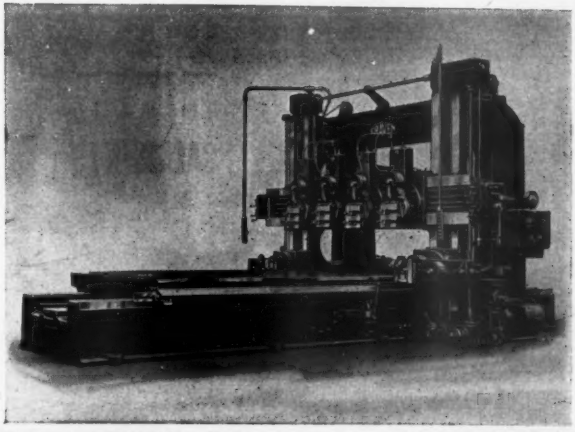

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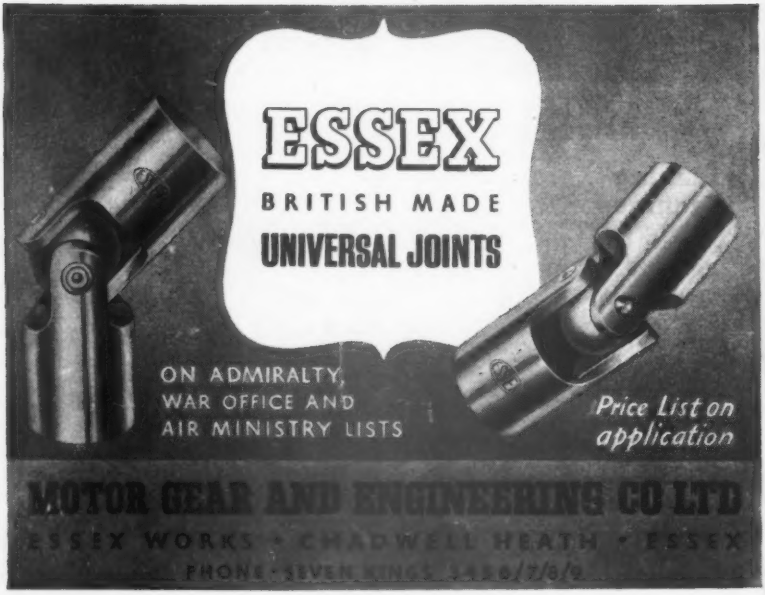
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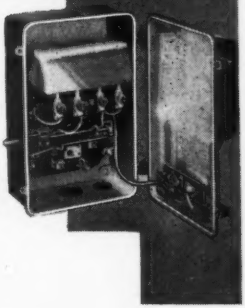

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# CHUCKS FOR MODERN HIGH SPEED DRILLING PRODUCTION

## THE "MARVEL" KEYLESS & THE "ARCHER" KEYLESS DRILL CHUCKS

are designed and constructed to stand up to modern drilling practice. The external design is robust and serves as an efficient casing to protect the internal mechanism. The jaws are protected from damage by the specially hardened boss or cap. The demand for this perfect chuck increases every year, evidence that the leading engineers appreciate its worth.

FIVE SIZES FROM $\frac{1}{16}$in. TO $\frac{5}{8}$in.

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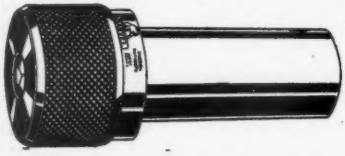
## The "ARCHER" KEYLESS DRILL CHUCK

is a correctly designed small size chuck working on the same principle as the "Marvel" which ensures reliable grip and ease of release. It has permanent concentricity and perfect balance for high speed drilling.

TWO SIZES: 0-$\frac{1}{2}$ in., 0-$\frac{5}{8}$ in.



**TURRET STYLE** *"Marvel"*

Shanks made solid from body giving short overhang for rigidity and alignment.

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Made in all capacities and various shank diameters.

ARCHER SMALL-TOOLS

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To the famous "X" series has now been added the "ER" heavy duty group. The range now includes a tool for every job up to closing 1¼ in. cup rivets.

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